

# National Weather Service

## *Advanced Storm Spotter Training*

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JASON DAVIS, METEOROLOGIST  
NWS BIRMINGHAM, AL



# Advanced Spotter Training Outline

*--Disclaimer: This is Not Storm Chaser Training--*



## Part I



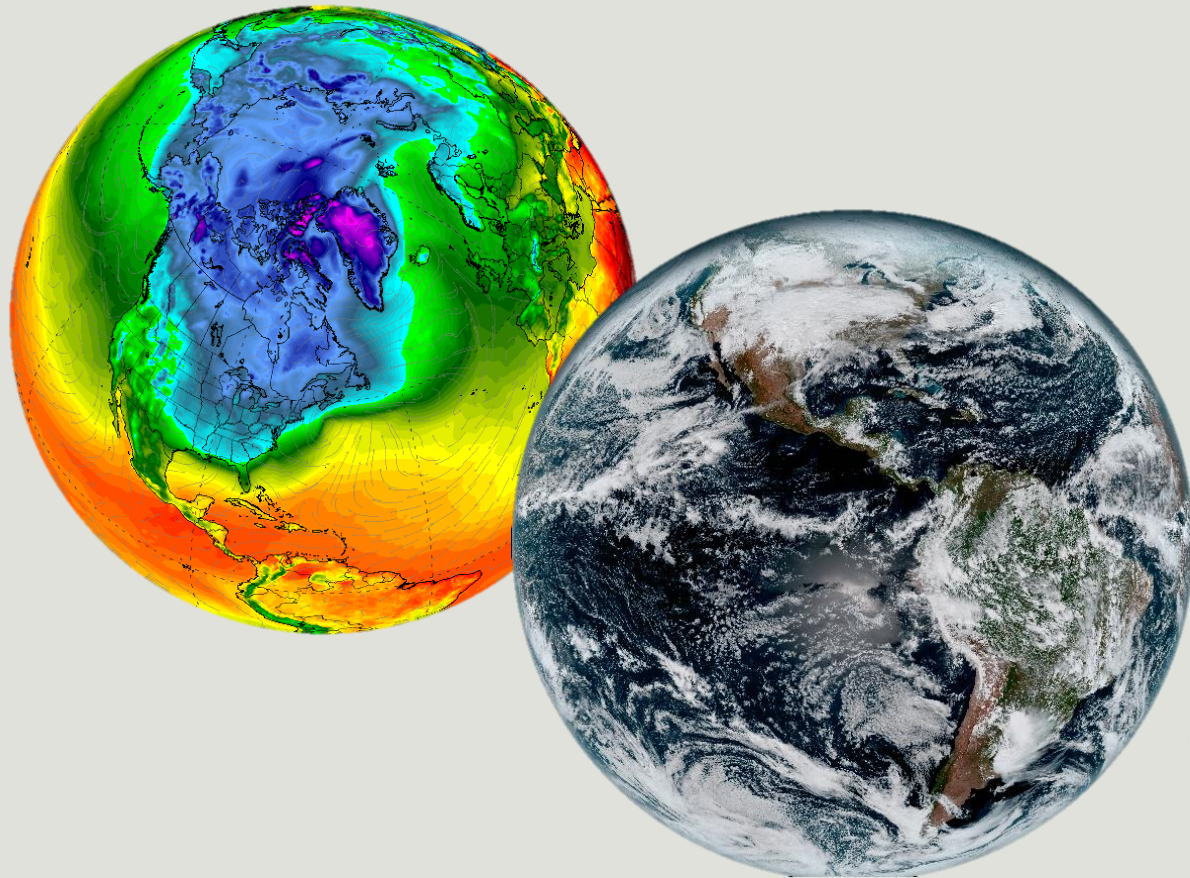
- Atmospheric features, types and scale
- Severe weather ingredients
- Using our products

## Part II

- Basic course recap
- RADAR signatures
- Tornadogenesis
- Demo a severe weather event

# The Atmosphere

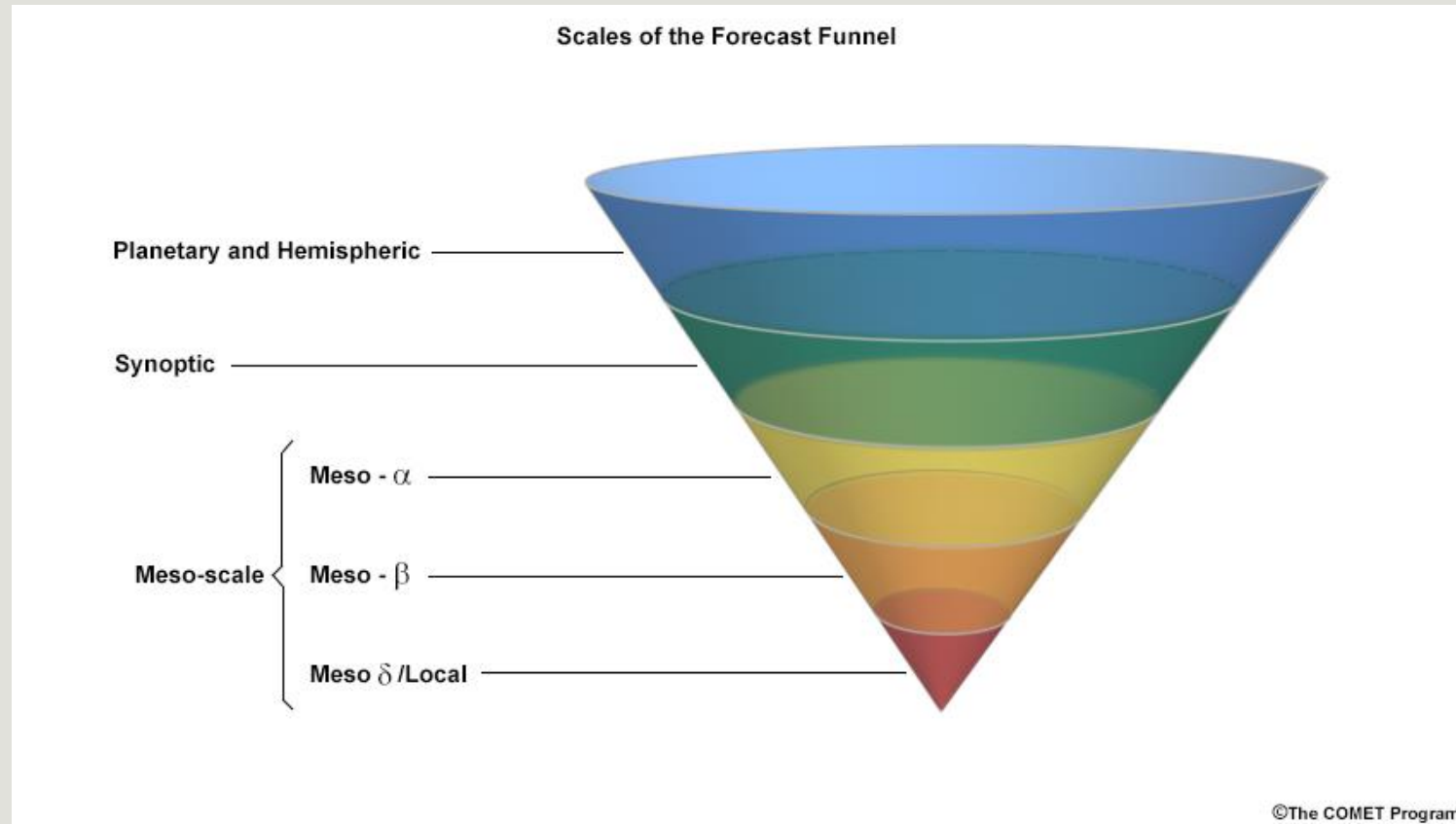
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## Large to Small Scale

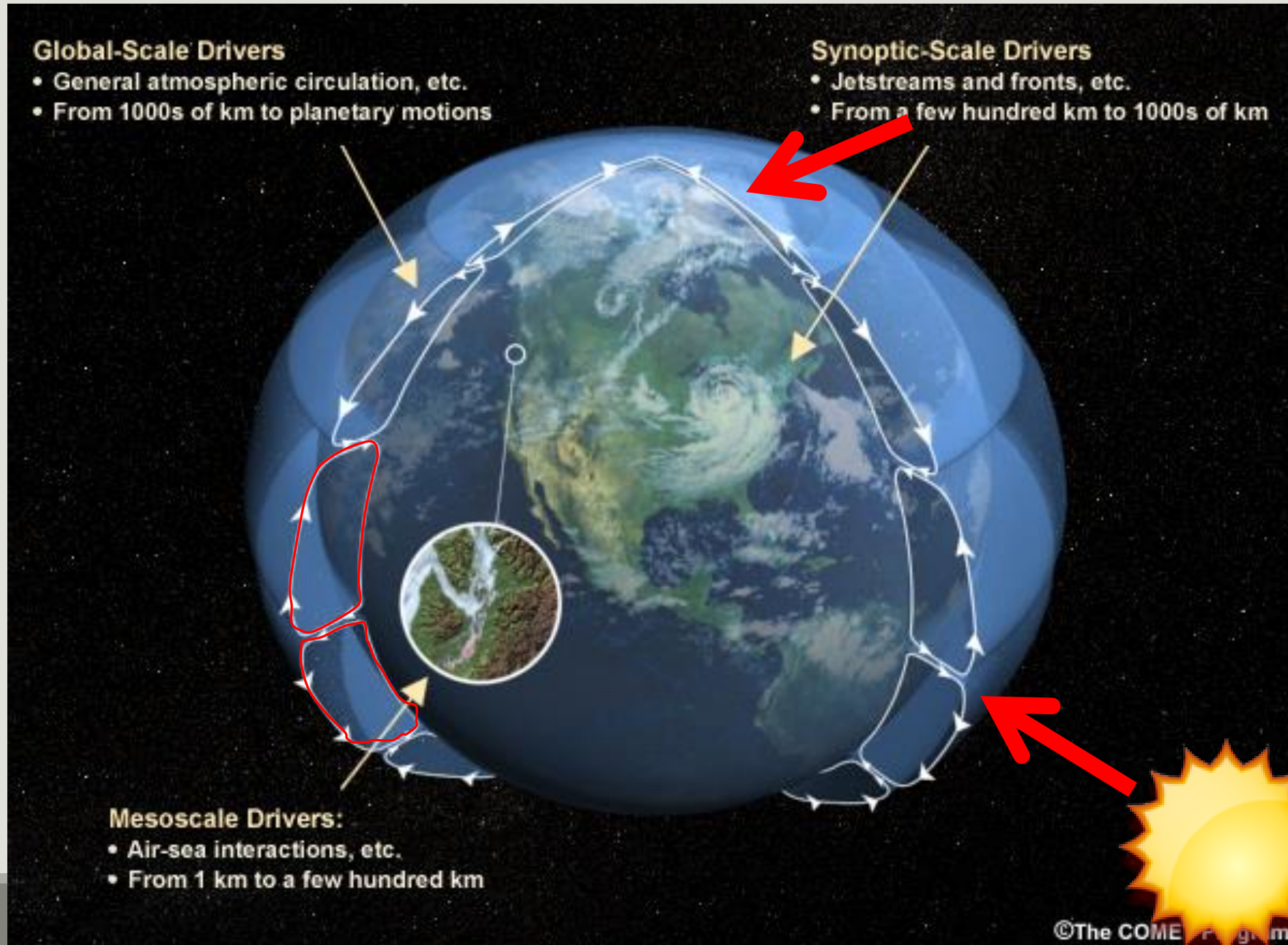
- *Global (Largest)*
- *Synoptic (Large)*
- *Mesoscale (Small)*

# “Forecast Funnel”

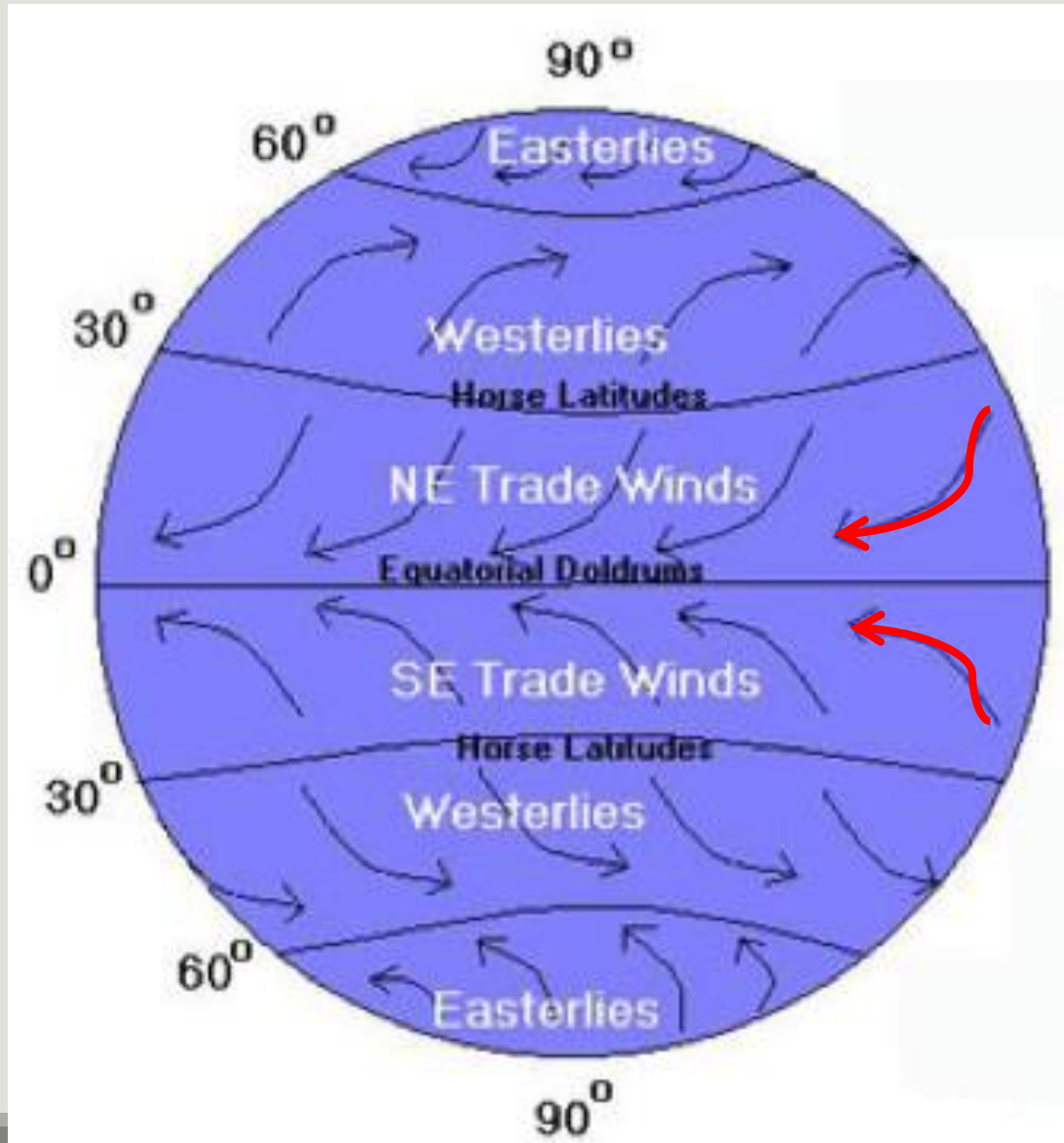




# Global Weather Patterns



# Global Weather Patterns



Weather Patterns  
should flow

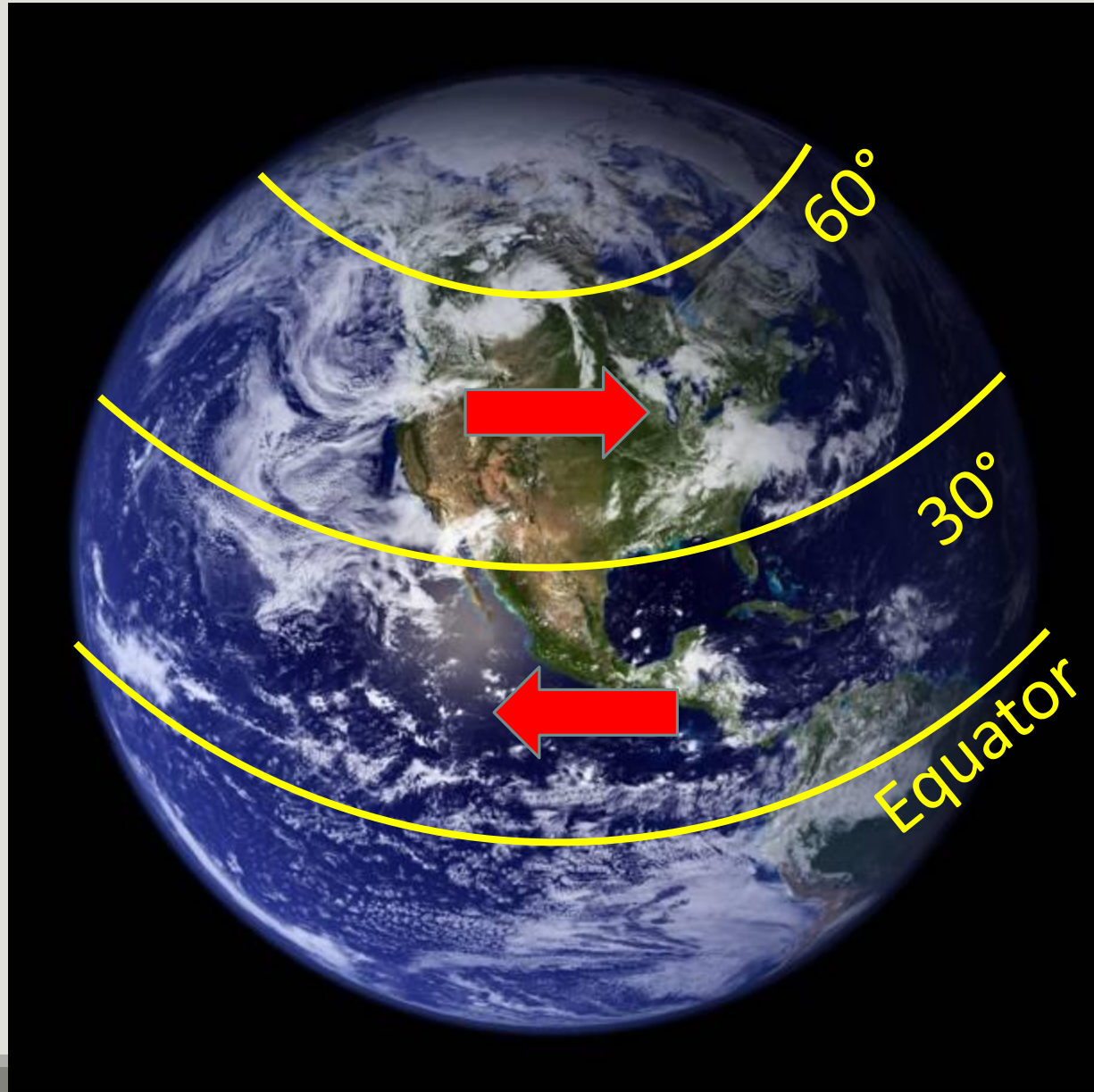
North to South, RIGHT?

Two More Things to  
Factor in:

- Rotation of the Earth
- Gravity

**Coriolis Effect**

# Global Weather Patterns

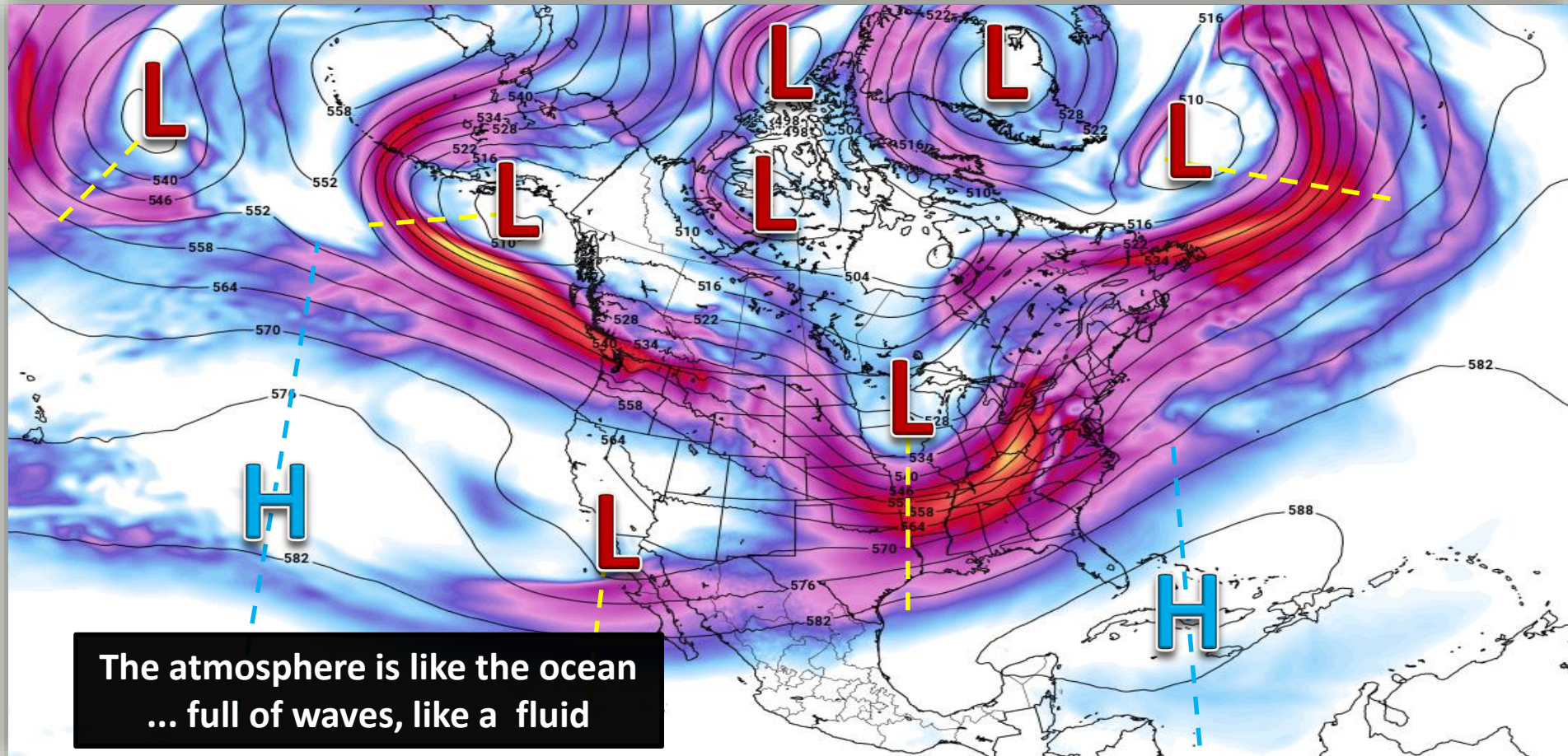


## Westerlies vs. Easterlies

- Most of our weather comes from the west
- Hurricanes come from the east

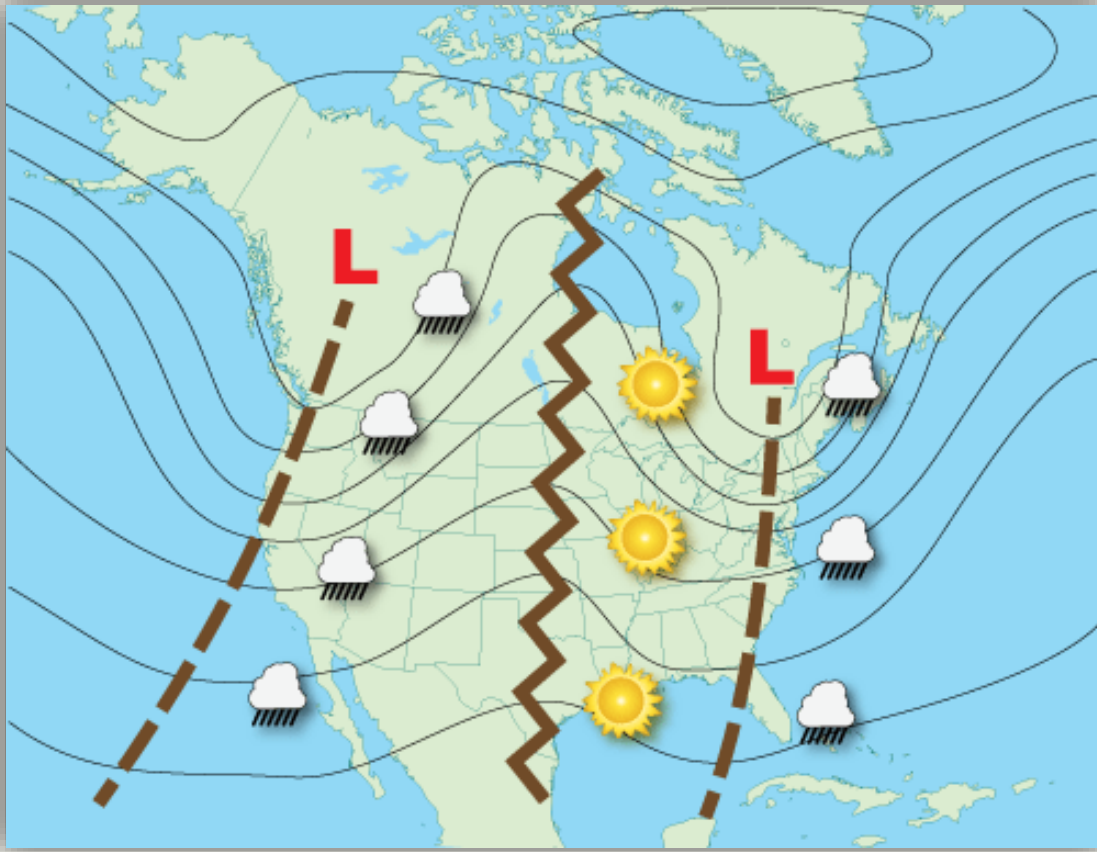


# Synoptic Weather Patterns



# Neutrally-Tilted Troughs

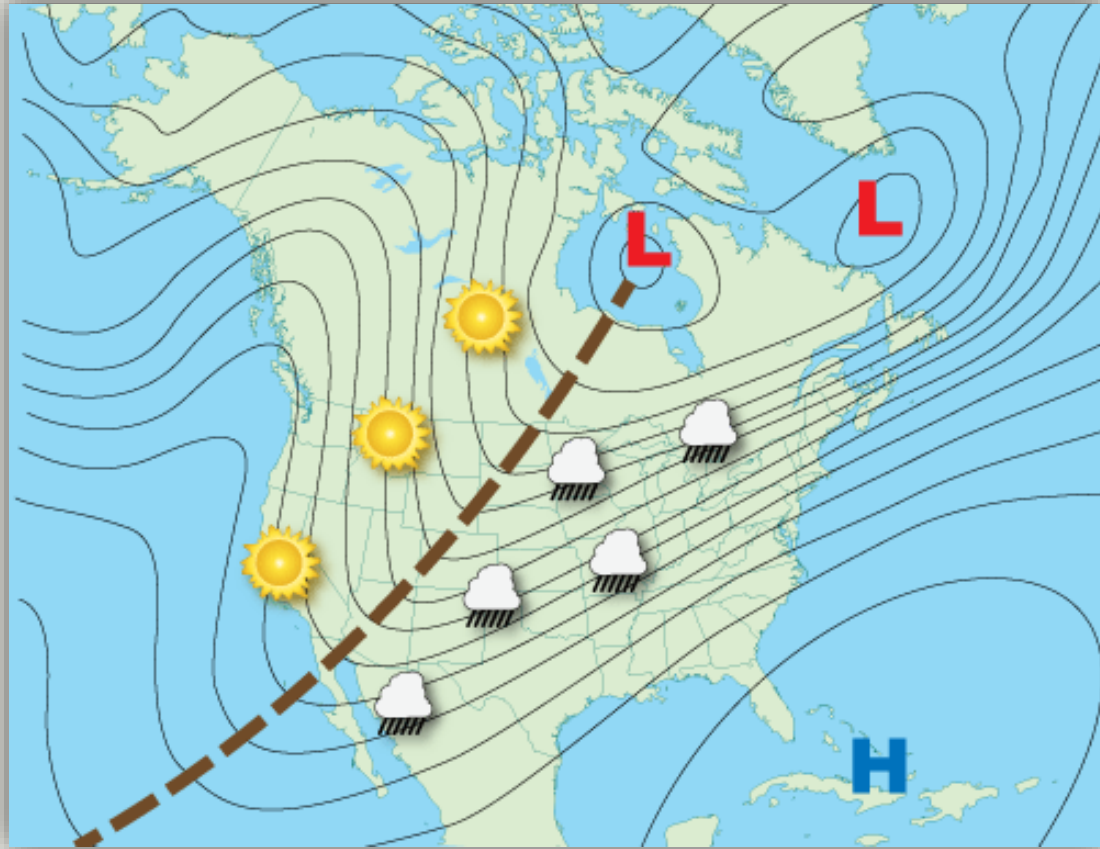
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- Trough axis extends from the lowest pressure north to south
- Active weather occurs between the trough and downwind (eastward) ridge

# Positively-Tilted Trough

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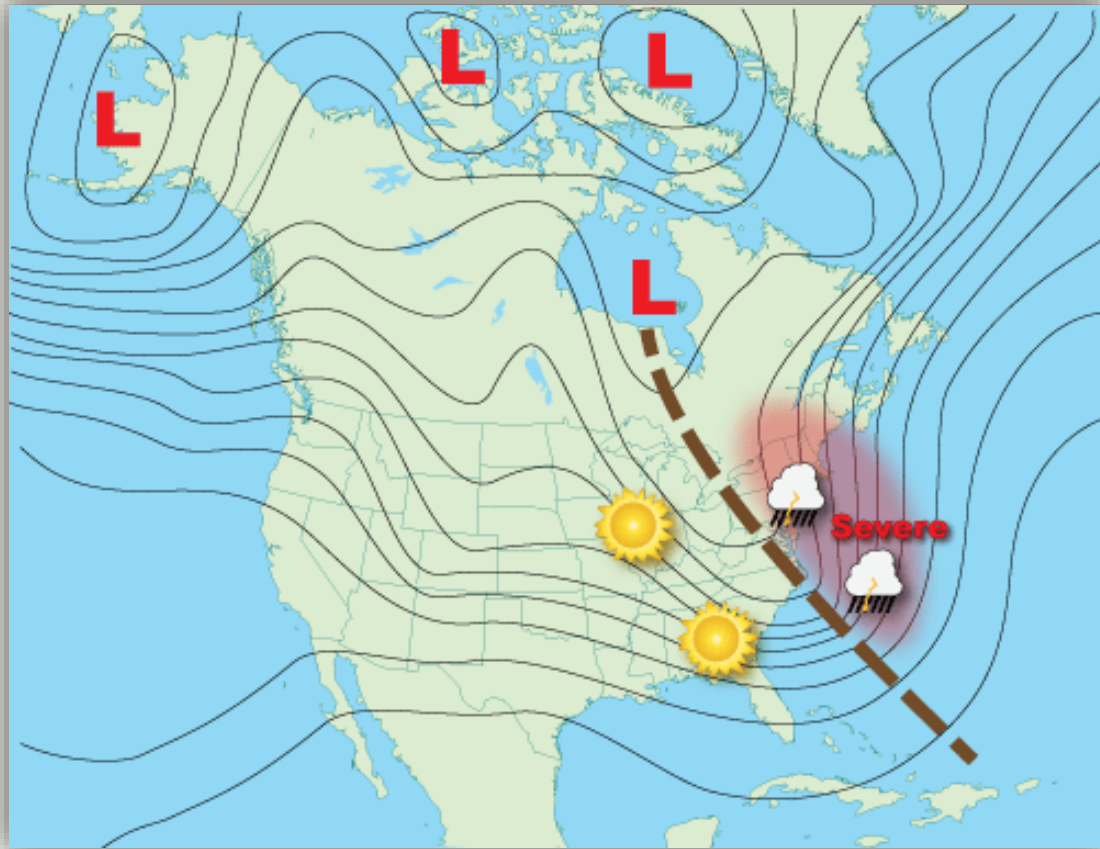


- Trough axis extends from the lowest pressure northeast to southwest
- Active weather can occur, but not 'too much' in the way of severe storms



# Negatively-Tilted Trough

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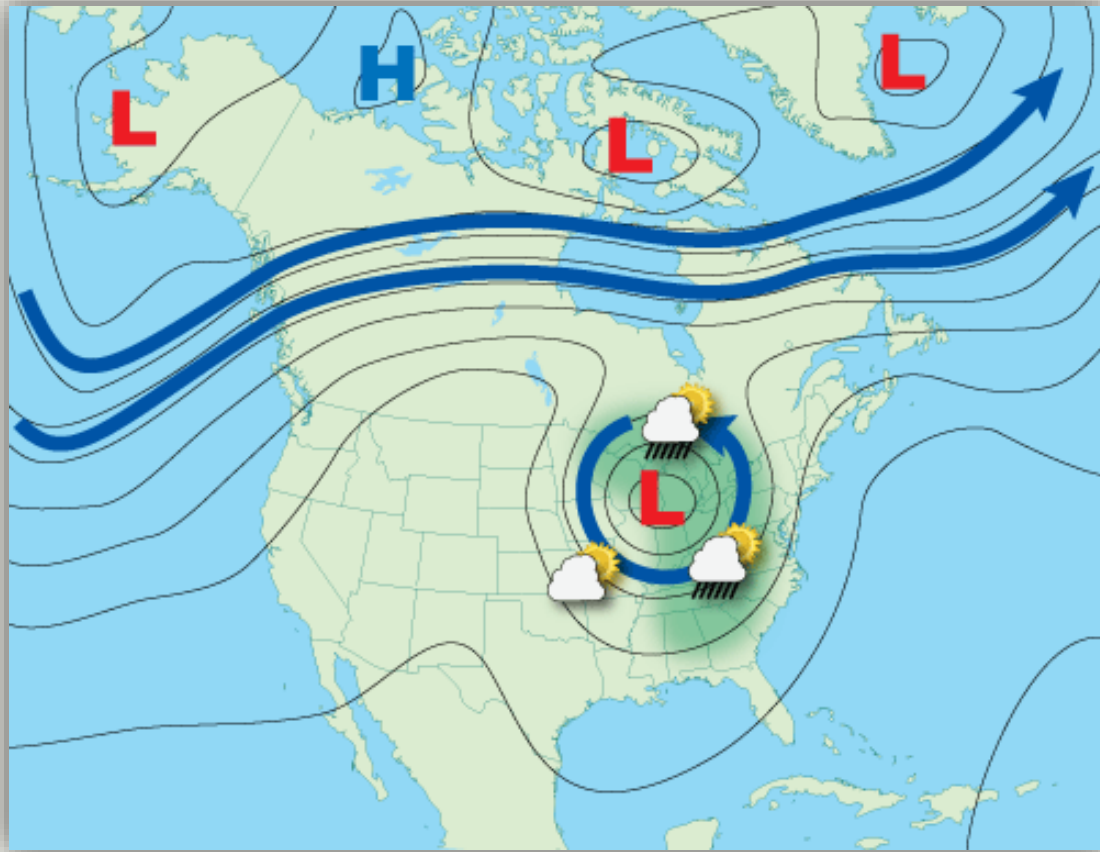


- Trough axis extends from the lowest pressure northwest to southeast
- Active weather + highest severe potential



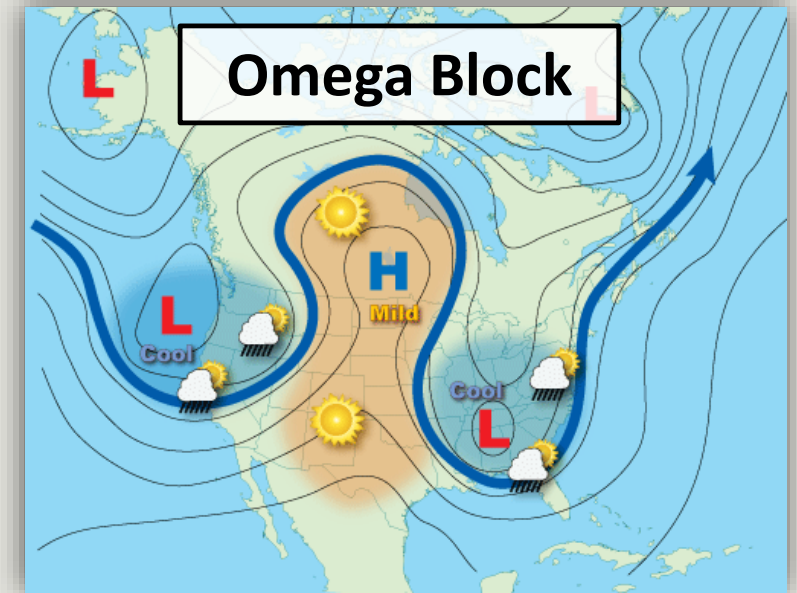
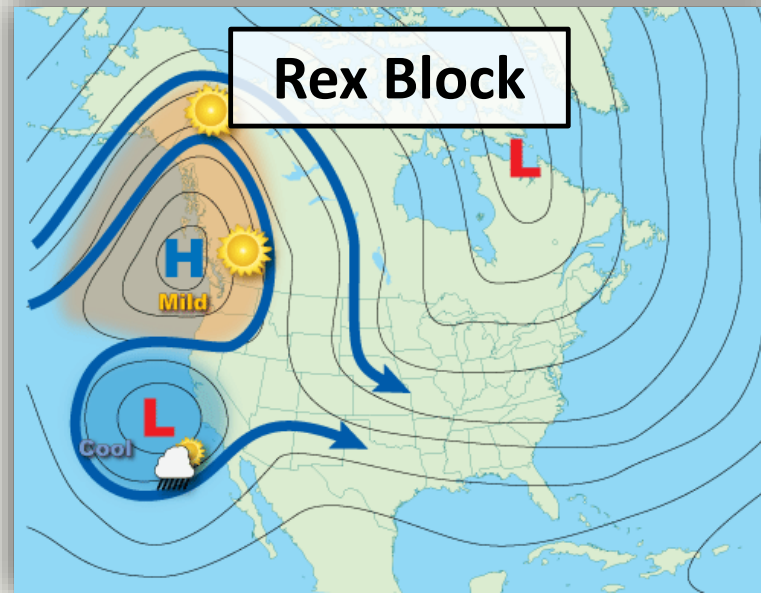
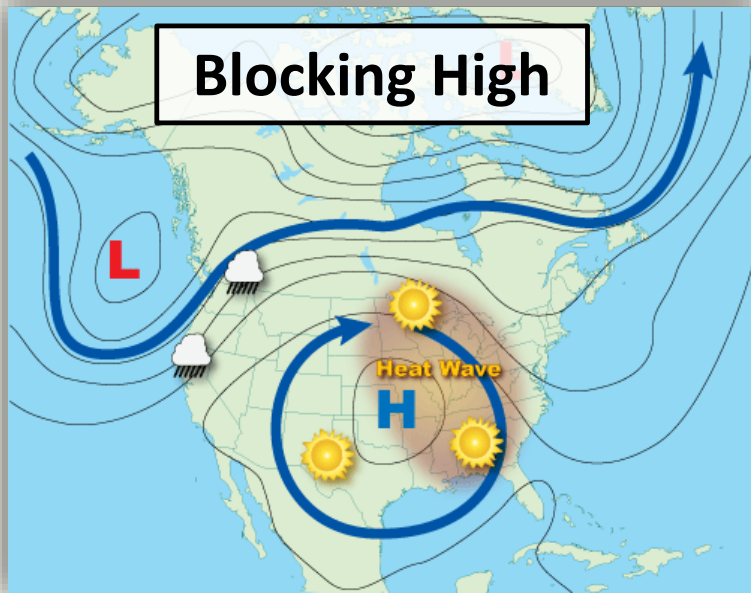
# Cut-off Low

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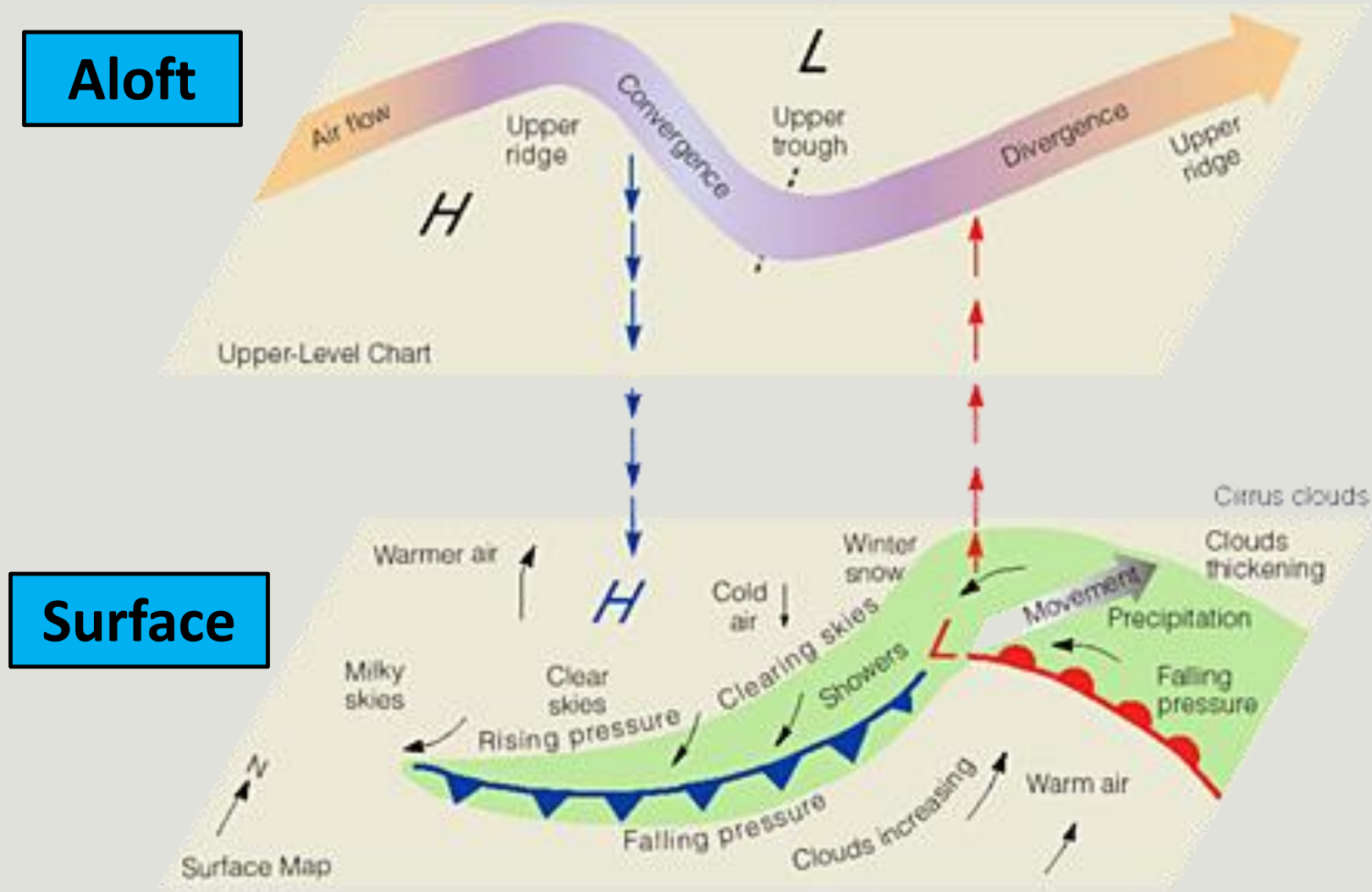
- Persistent area of low pressure removed from the steering flow
- Can meander for several days, sometimes over a week
- Produce unsettled weather

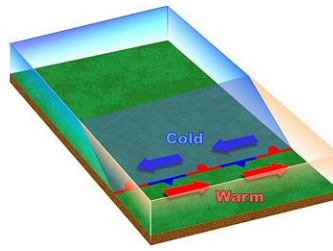
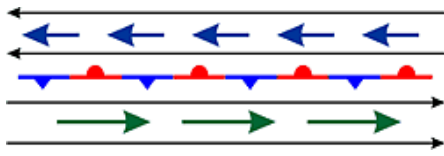
# Blocking Patterns



- When weather systems set up in a way that prevents progressive movement
- Result in long spans of persistent weather conditions for a given area

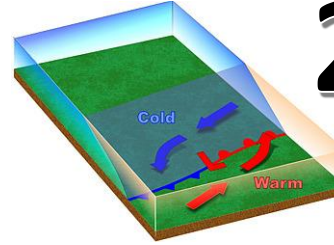
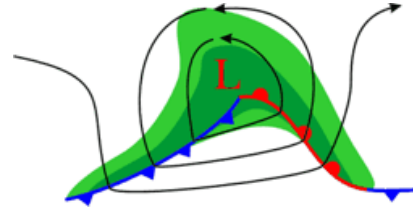
# Synoptic Weather Patterns: Top-down





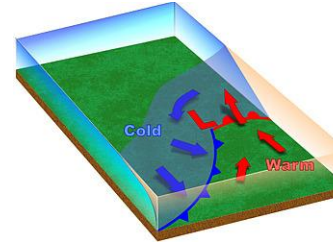
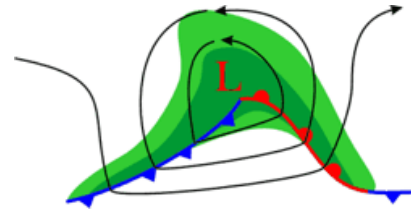
**1**

Boundary between warm, cooler air



**2**

With upper-level impulse, surface wave forms; precipitation develops

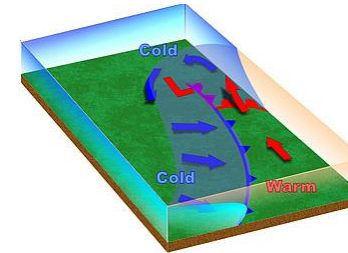
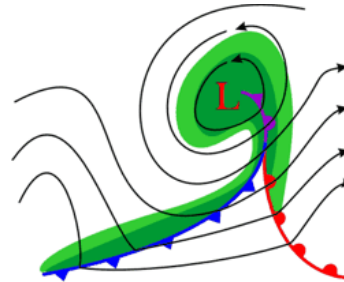


**3**

Wave intensifies, fronts become better organized

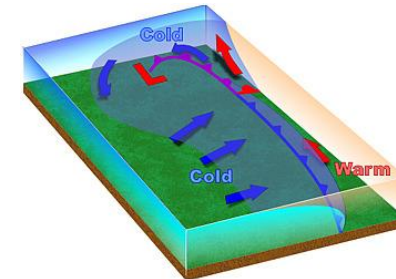
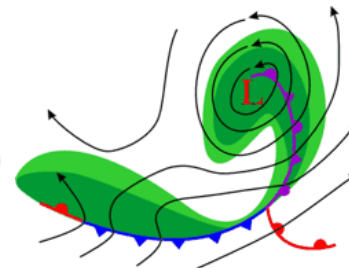
Low pressure matures. Cold front overtakes warm front and forms an occluded front

**4**



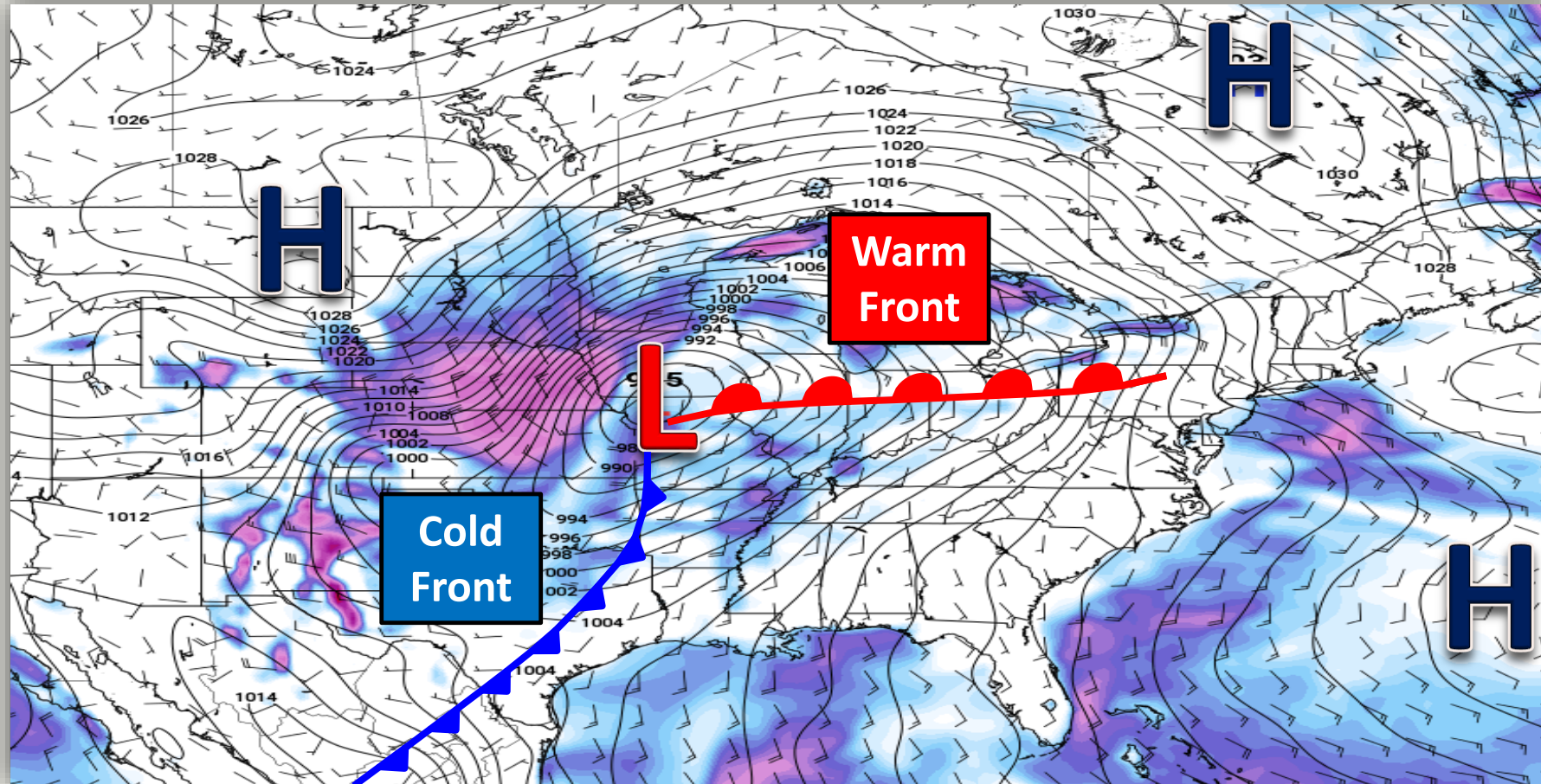
Cold front continues to advance on warm front and eventually cuts off supply of warm, moist air. Low pressure gradually dissipates

**5**

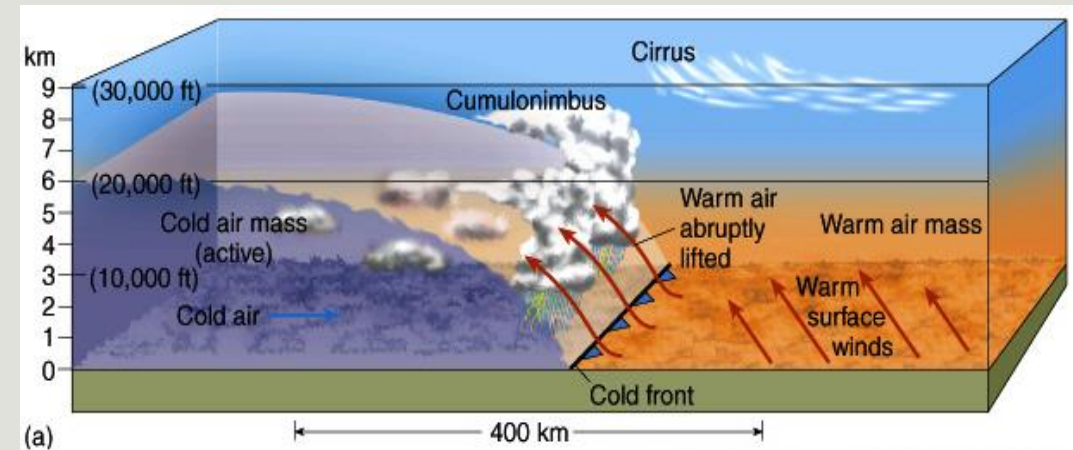
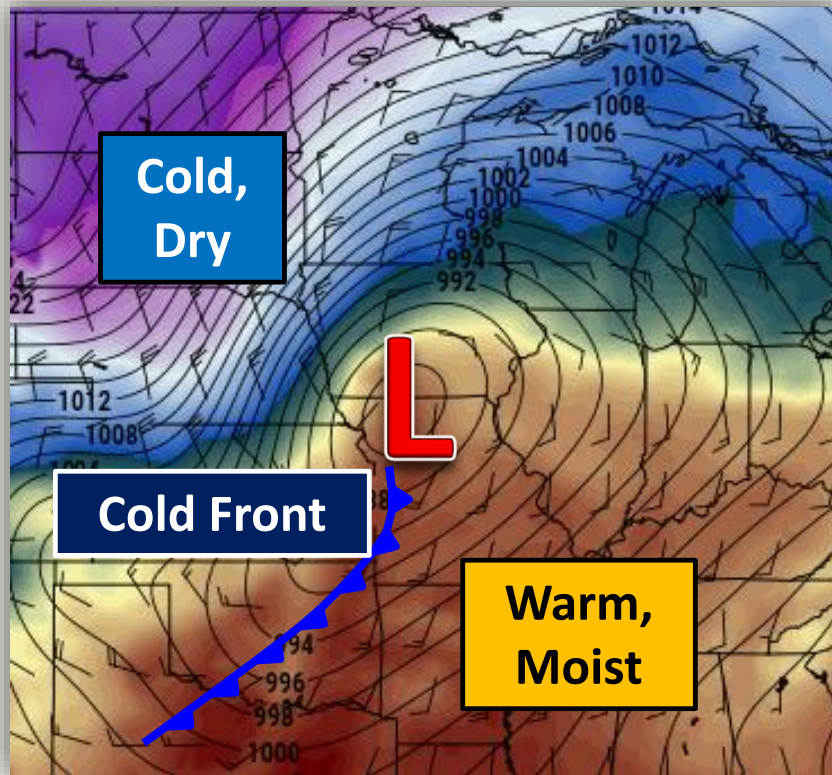




# Features Associated with Surface Low Pressure



# Cold Front Structure



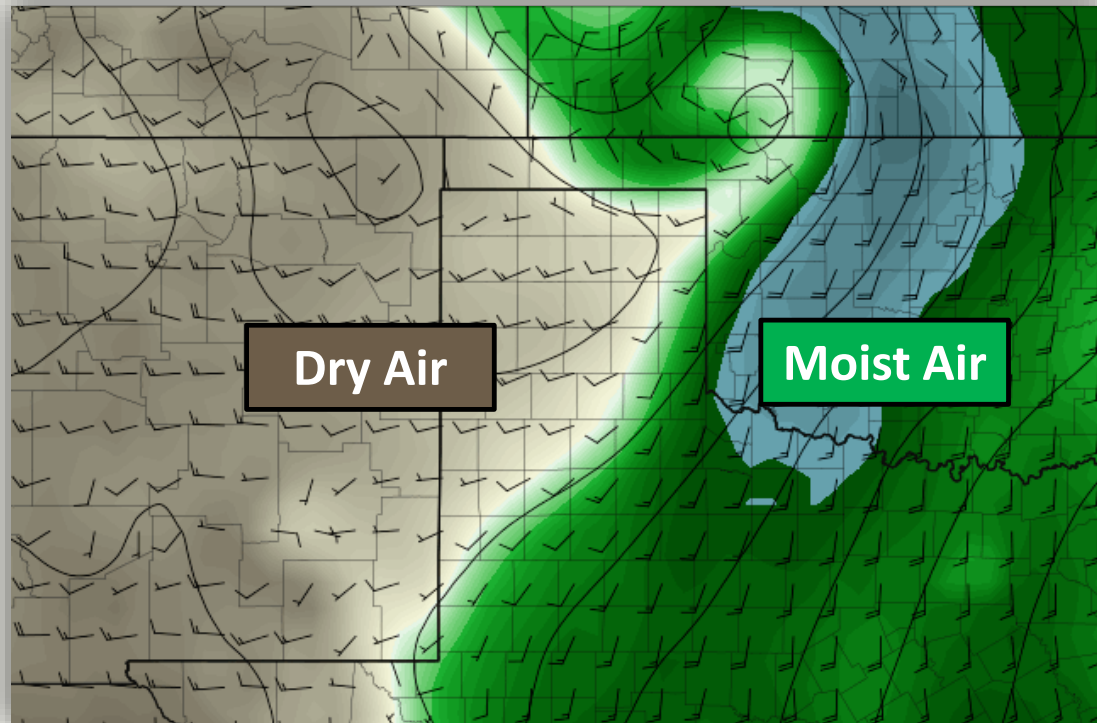
**Cold front definition: A zone separating two air masses, of which the cooler, denser mass is advancing and replacing the warmer air mass**



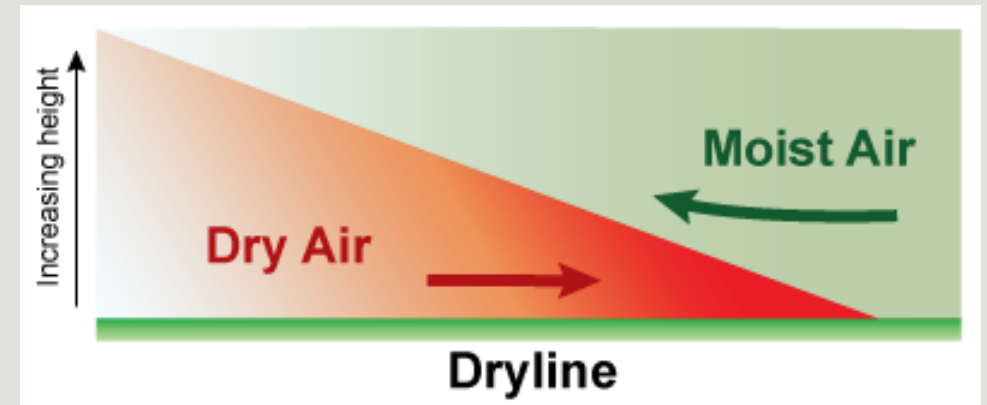




# Other Boundaries – Dryline

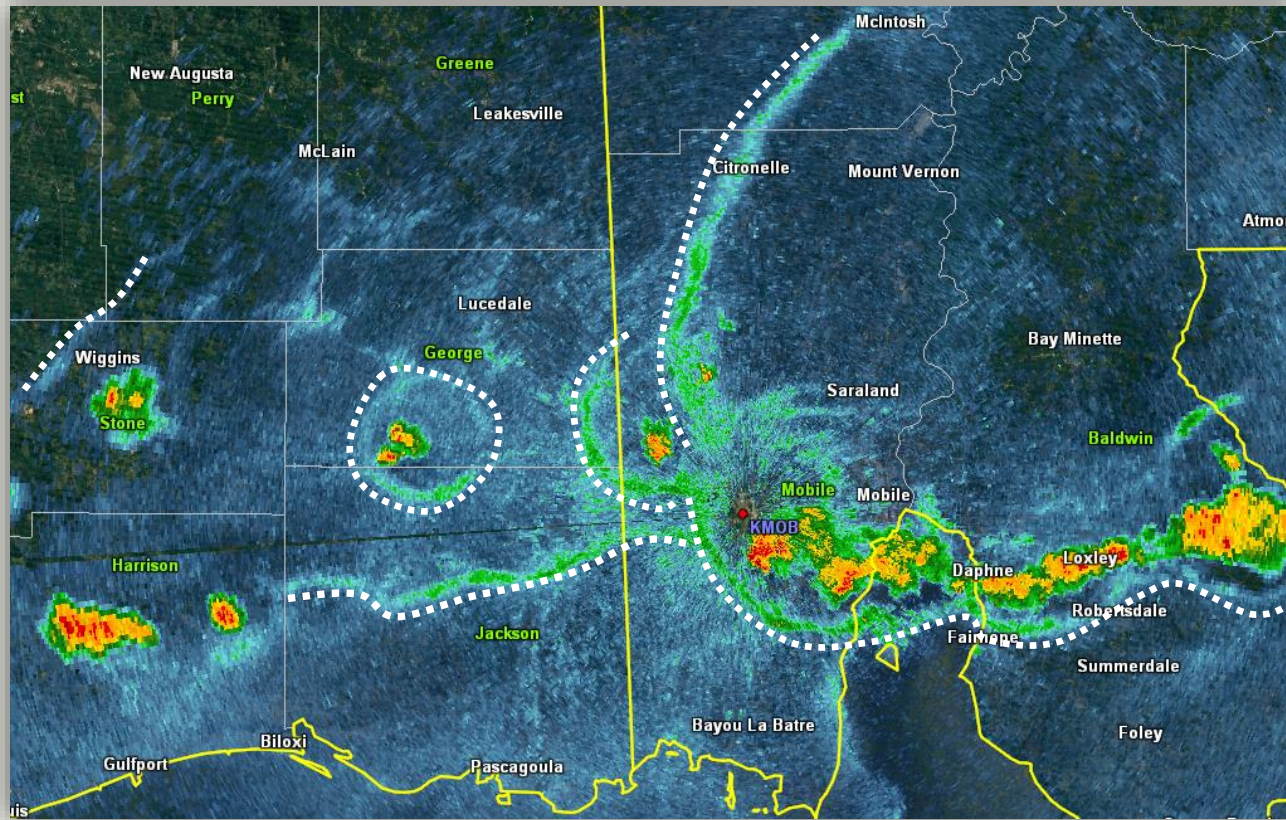


\*most common in the Plains, though strong weather systems can sometimes sweep the dryline eastward into the Mississippi Valley region



**Dryline definition: The boundary between a moist and dry air mass. Dry air forces moist air upward as the boundary moves eastward, which can trigger severe storms.**

# Other Boundaries – Outflow



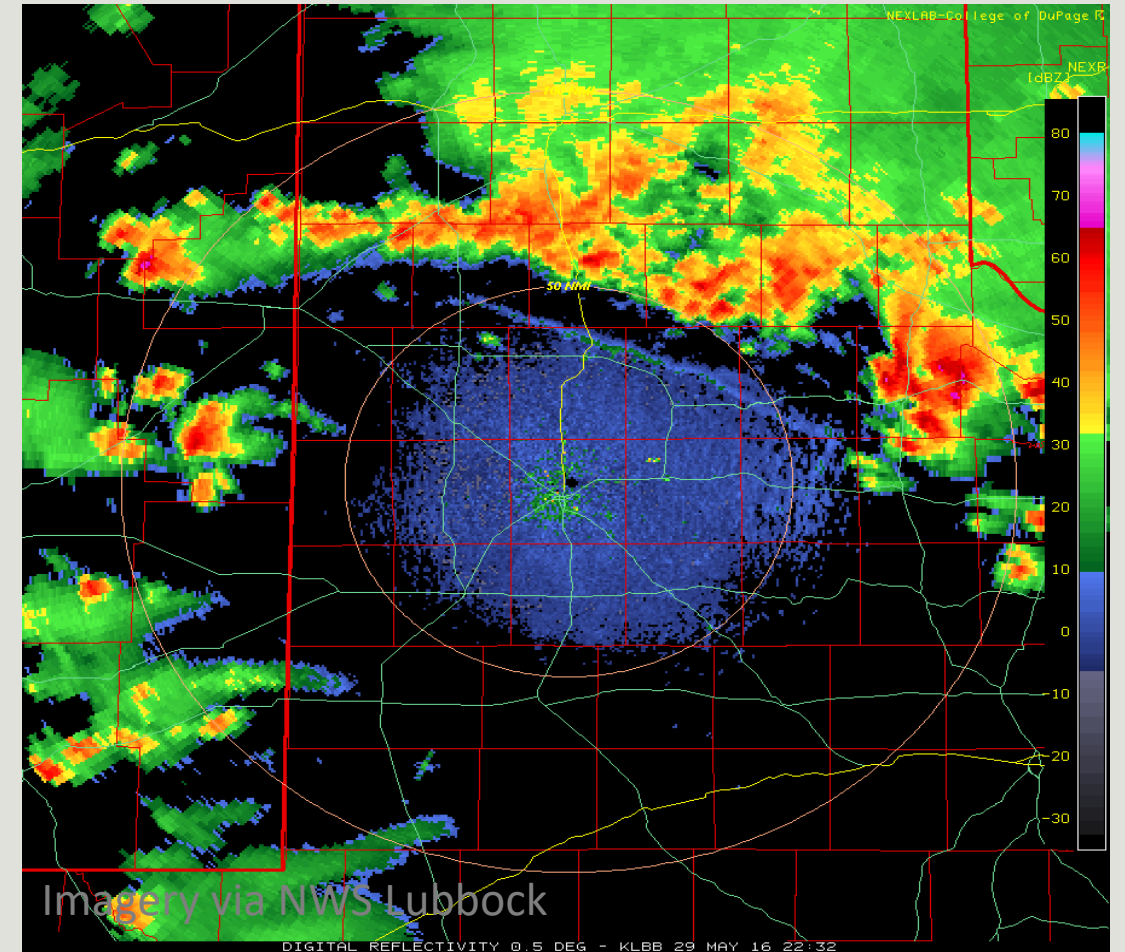
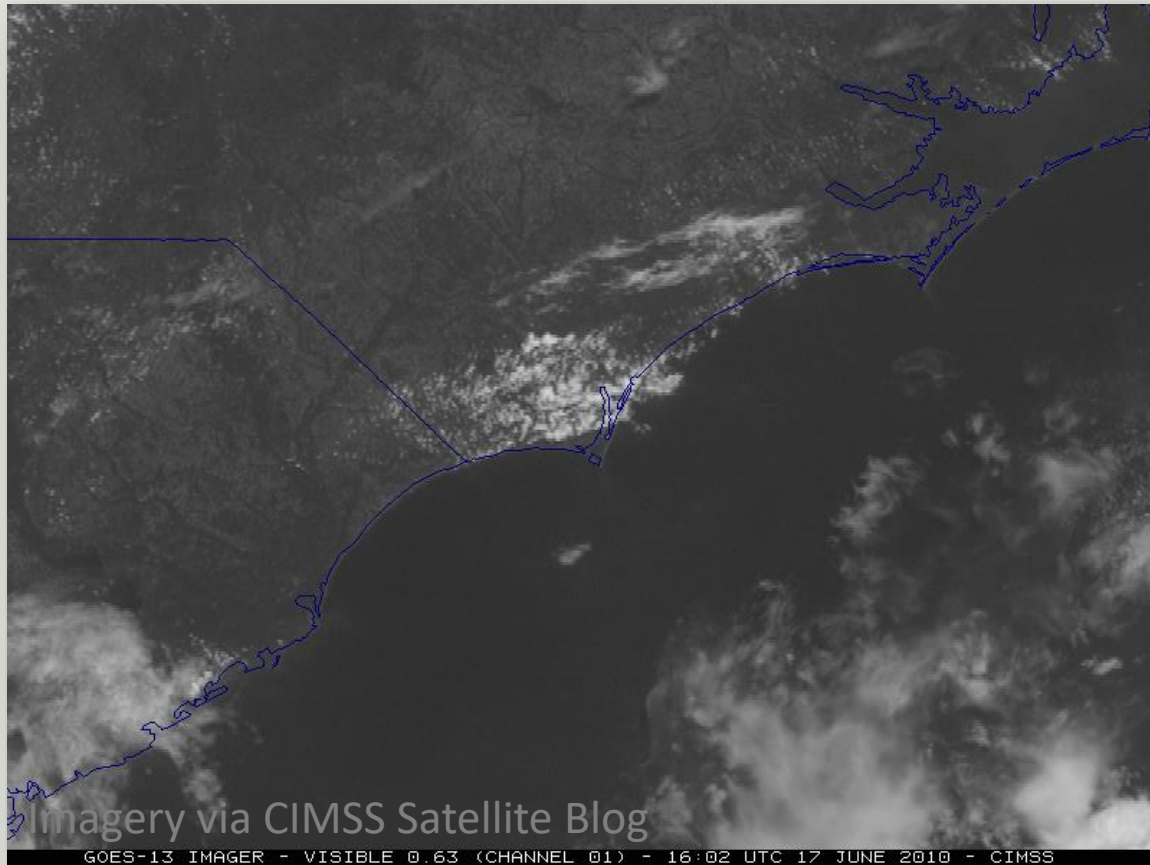
**Outflow boundary definition: A small-scale boundary that separates rain-cooled air from the surrounding air**

\*similar in effect to a cold front. Passage is marked with a wind shift/increase and drop in temperature. These boundaries can trigger new showers and storms.



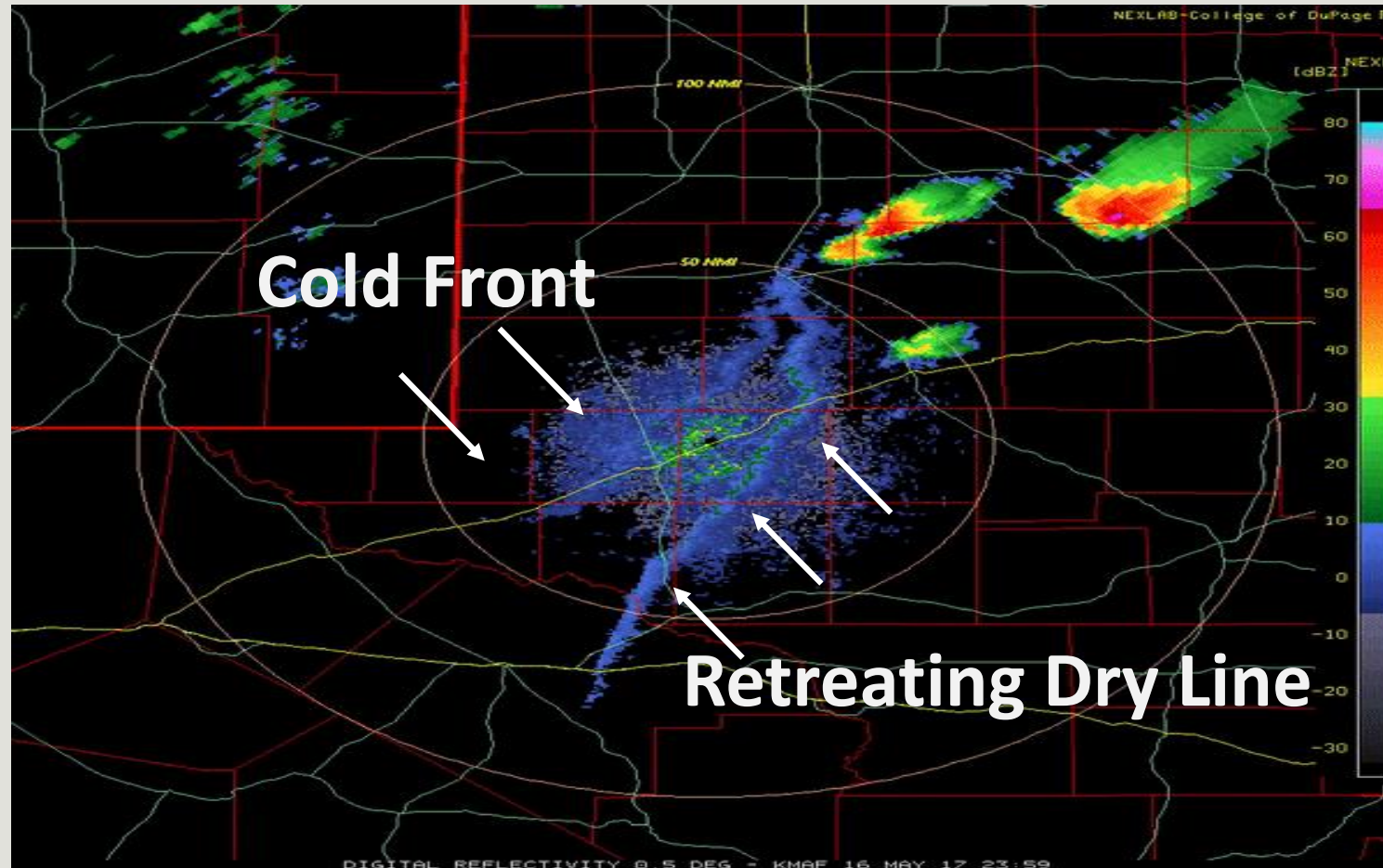
# Outflow Boundaries in Action (GIF)

--via Satellite and RADAR--



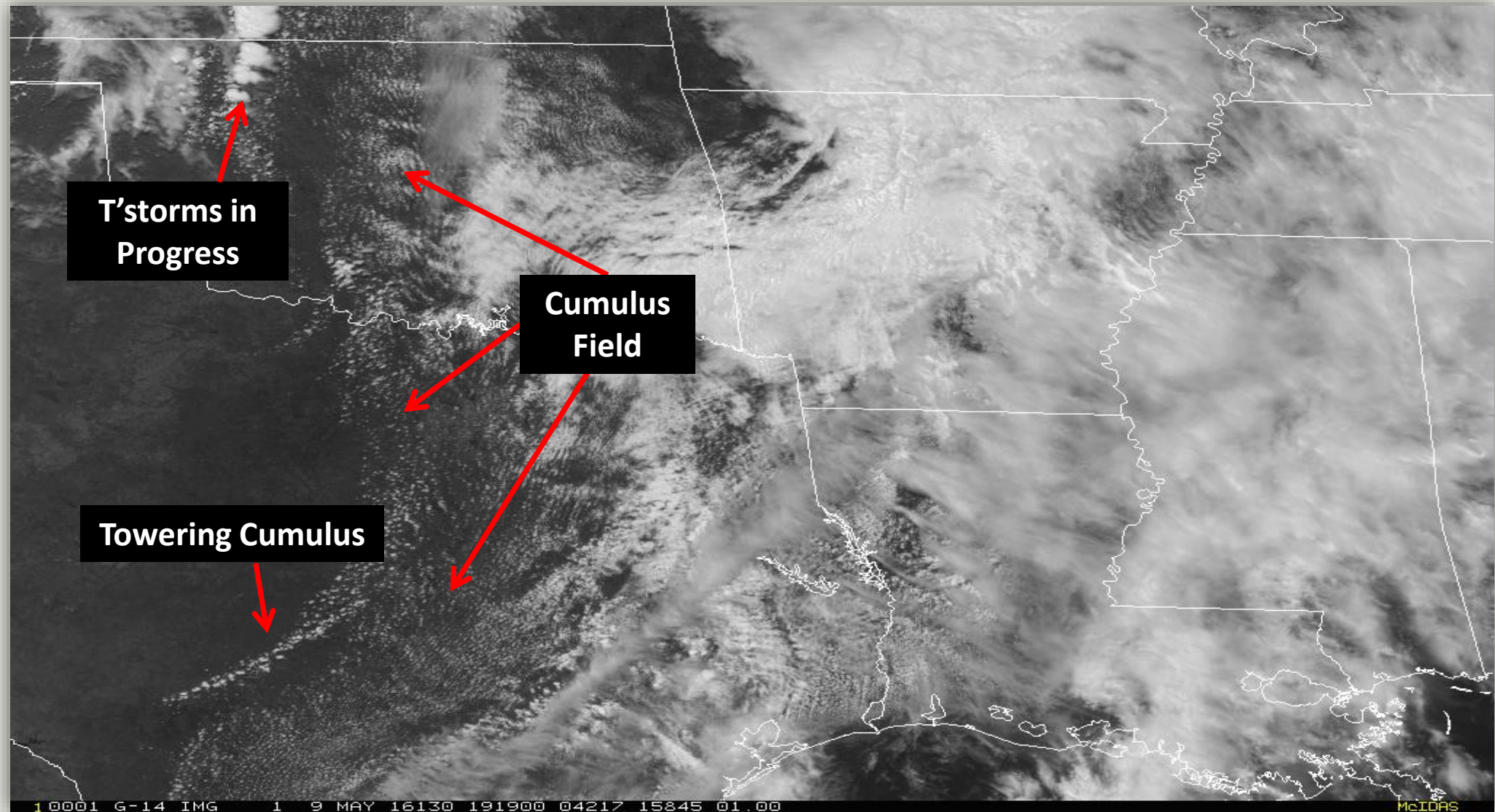
# Collision of 2 Boundaries

## --Interesting Things Happen at the Boundaries--





# Stages of Activity



# GOES-16 One-Minute Imagery



1 0001 G-16 IMG 2 8 JUN 17159 233053 00697 00736 01.00 CIRA/RAMMB

# Advanced Spotter Training Outline

*--Disclaimer: This is Not Storm Chaser Training--*



## Part I

- Atmospheric features, types and scale
- Severe weather ingredients
- Using our products



## Part II

- Basic course recap
- RADAR signatures
- Tornadogenesis
- Demo a severe weather event



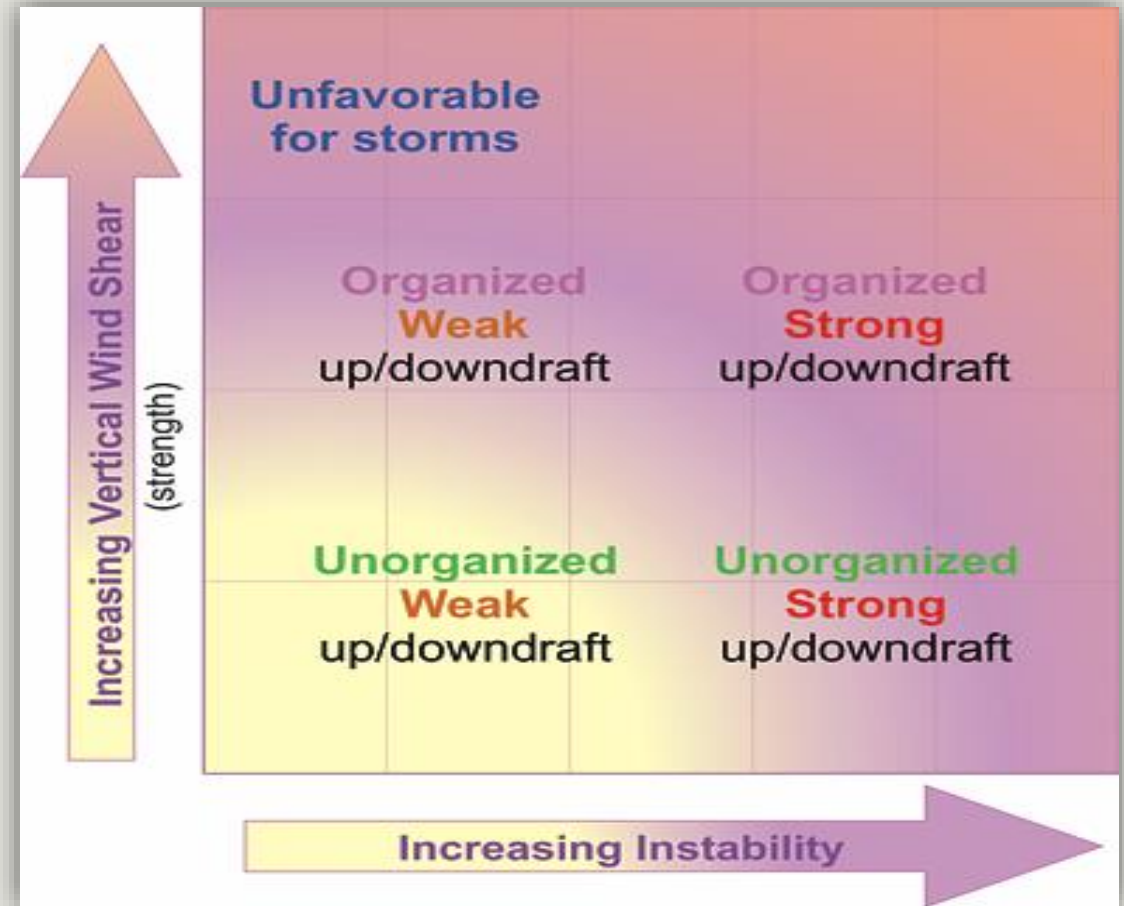
# Ingredients for Thunderstorm Formation

- Source of lift
  - Cold front
  - Warm front
  - Gust front/outflow boundary
  - Terrain (upslope flow)
  - Surface heating

- Moisture

- Instability

\*Wind shear helps with thunderstorm organization/longevity and severity





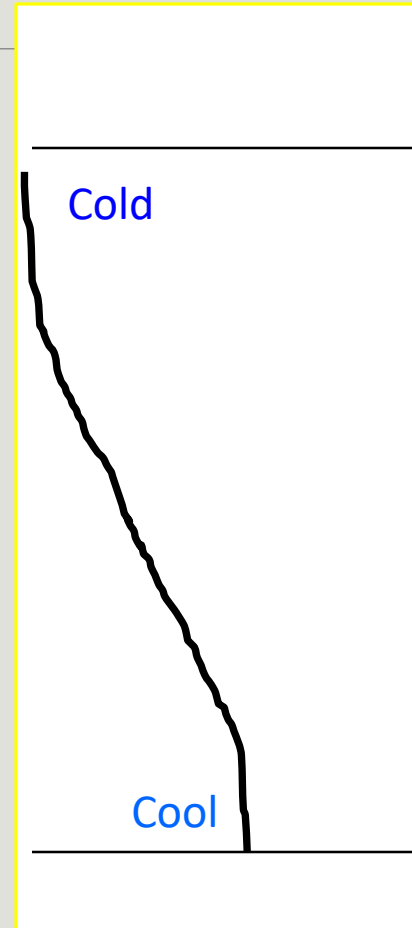
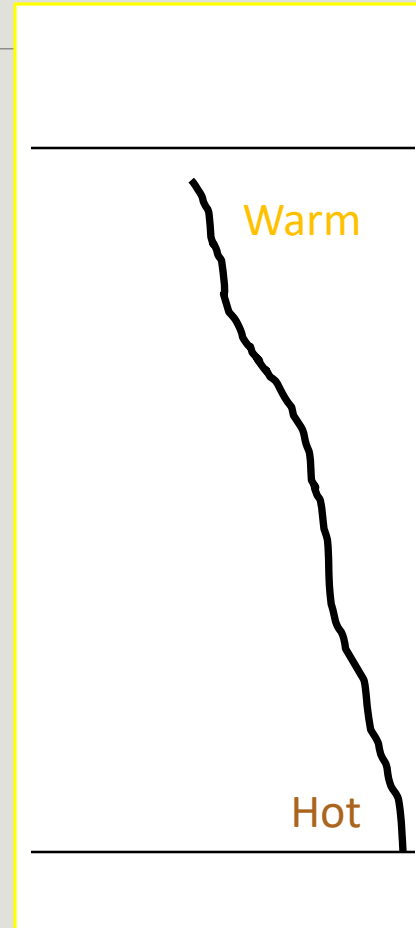
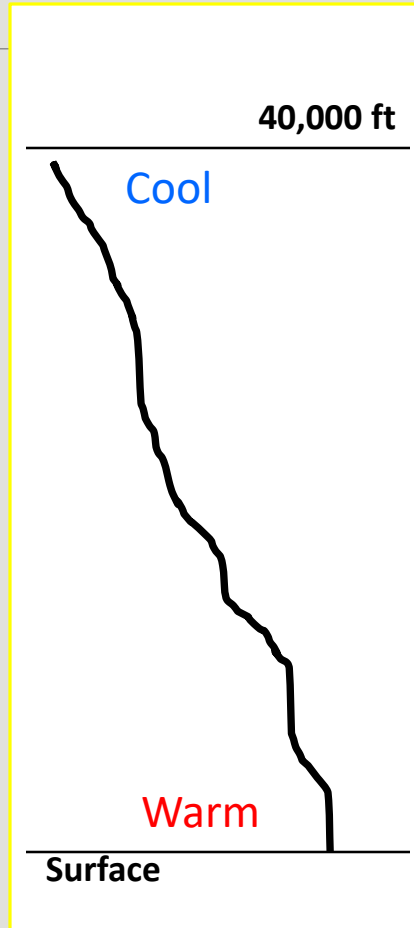
# The 3-Dimensional Atmosphere Instability



General

Summer

Winter



In basic terms, the instability of the atmosphere is measured based upon how warm it is at the surface versus how cold it is aloft.

In general, the atmosphere gets colder as you go up.

During the summer, it is a lot hotter at the surface, but it also warm aloft

In the winter it is colder at the surface, but it is also colder in the upper atmosphere, as well.

Temperature  
Increasing →



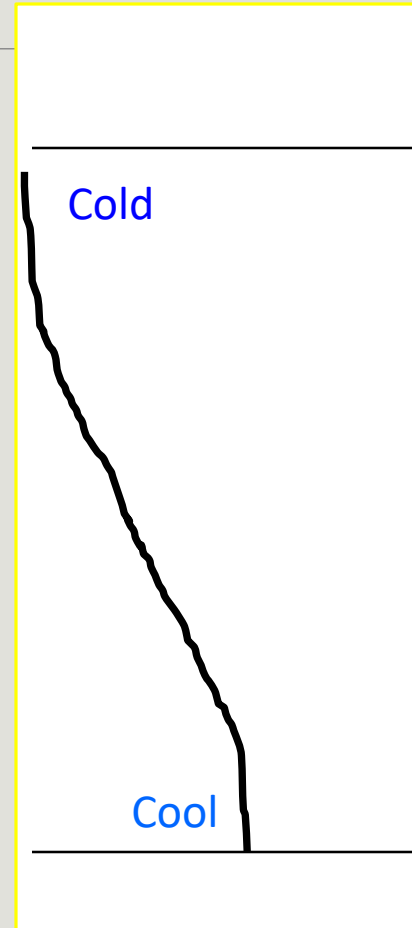
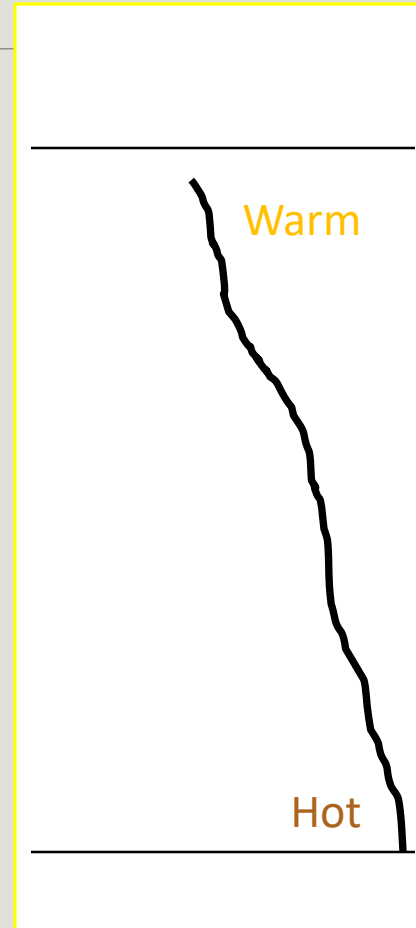
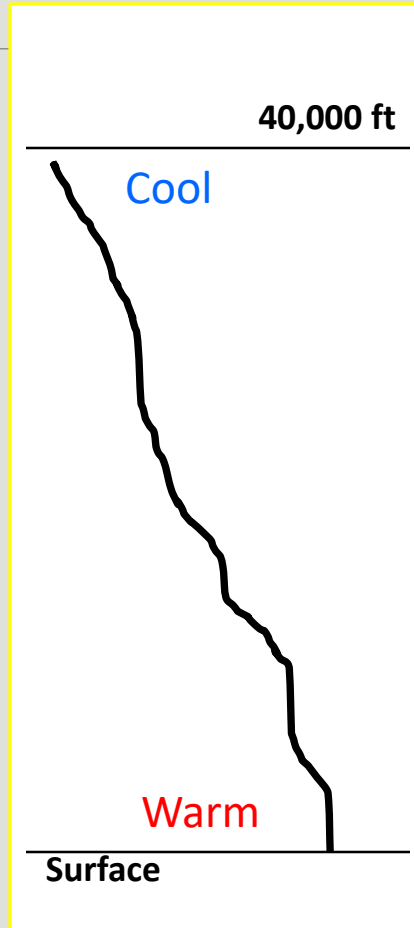
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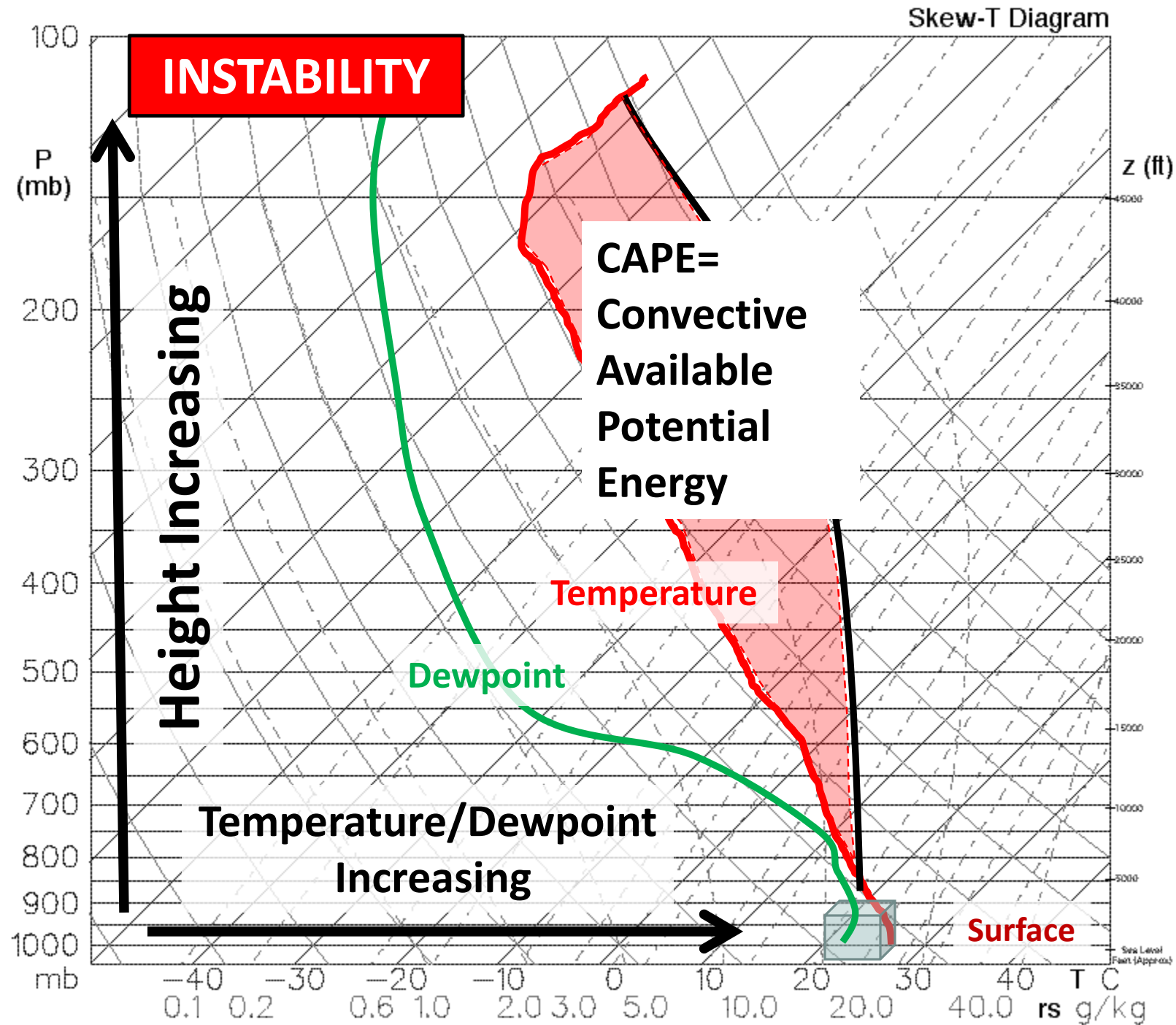
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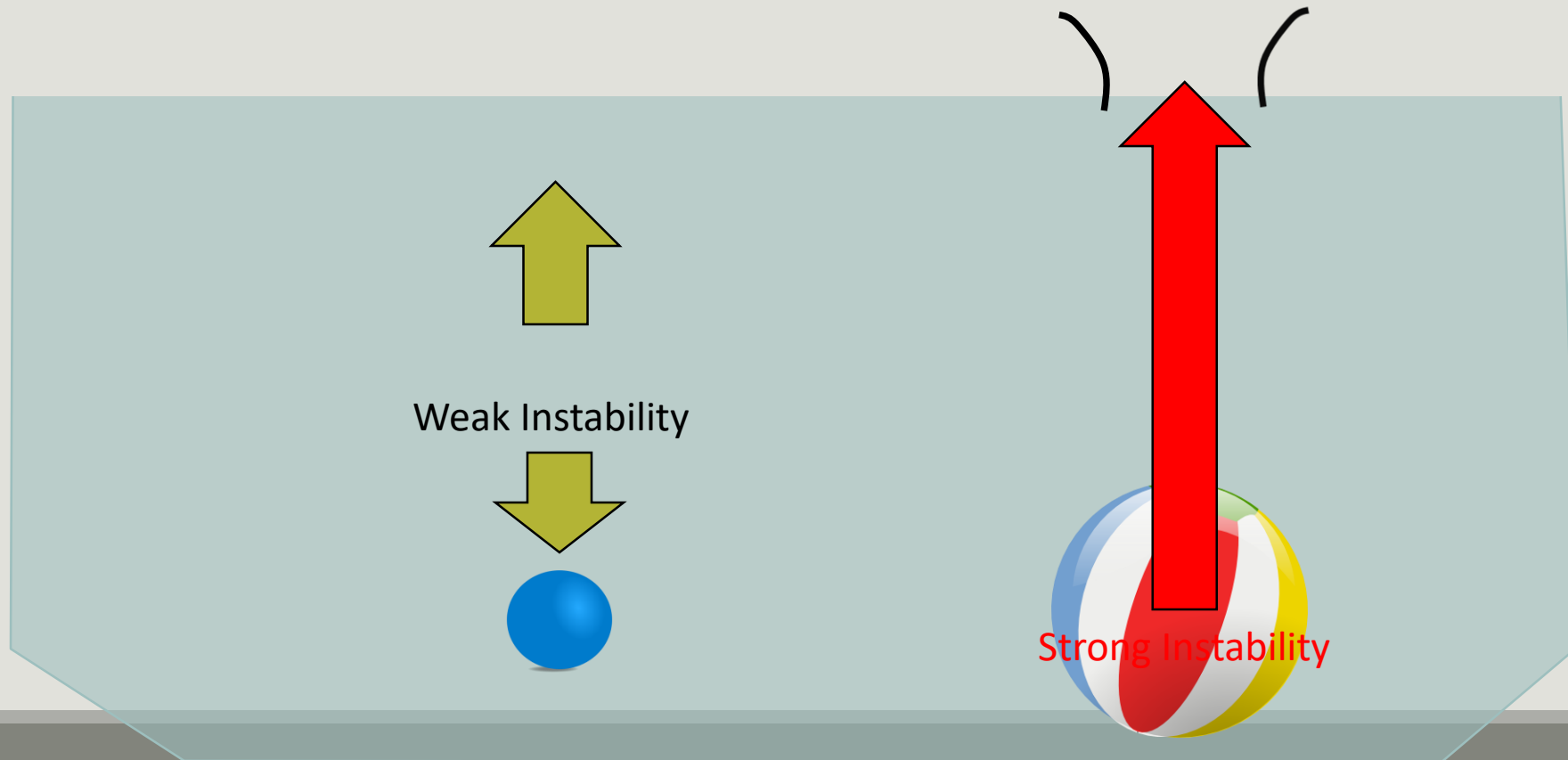
**How is the instability calculated?**

Temperature  
Increasing →

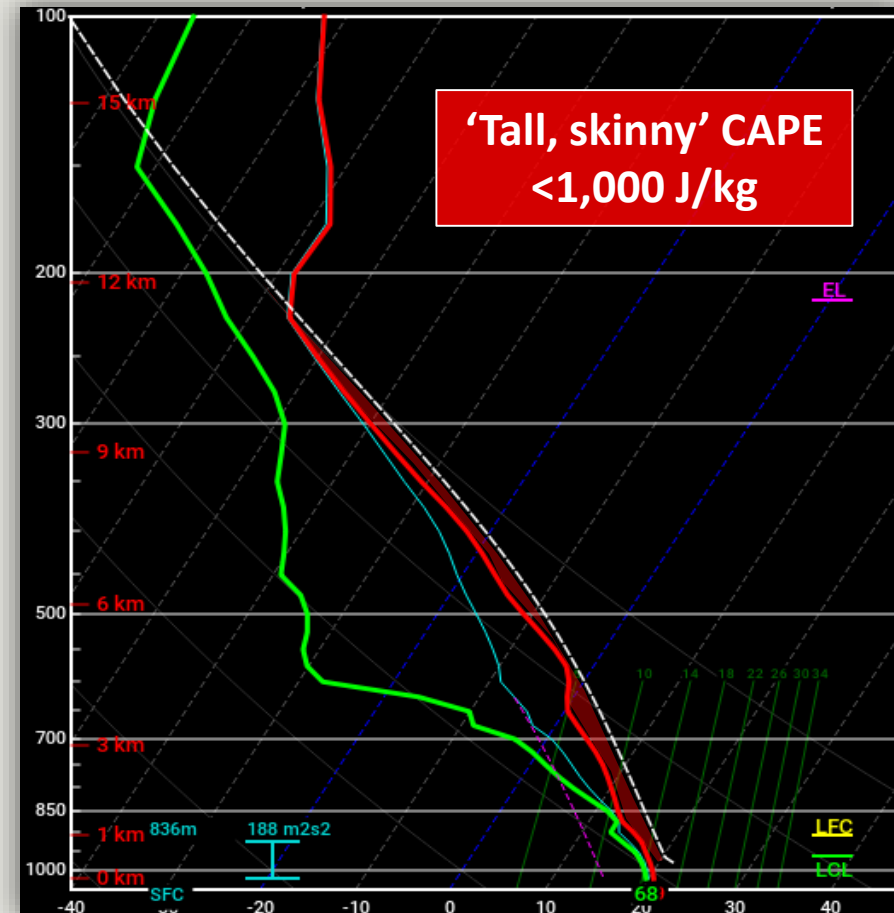
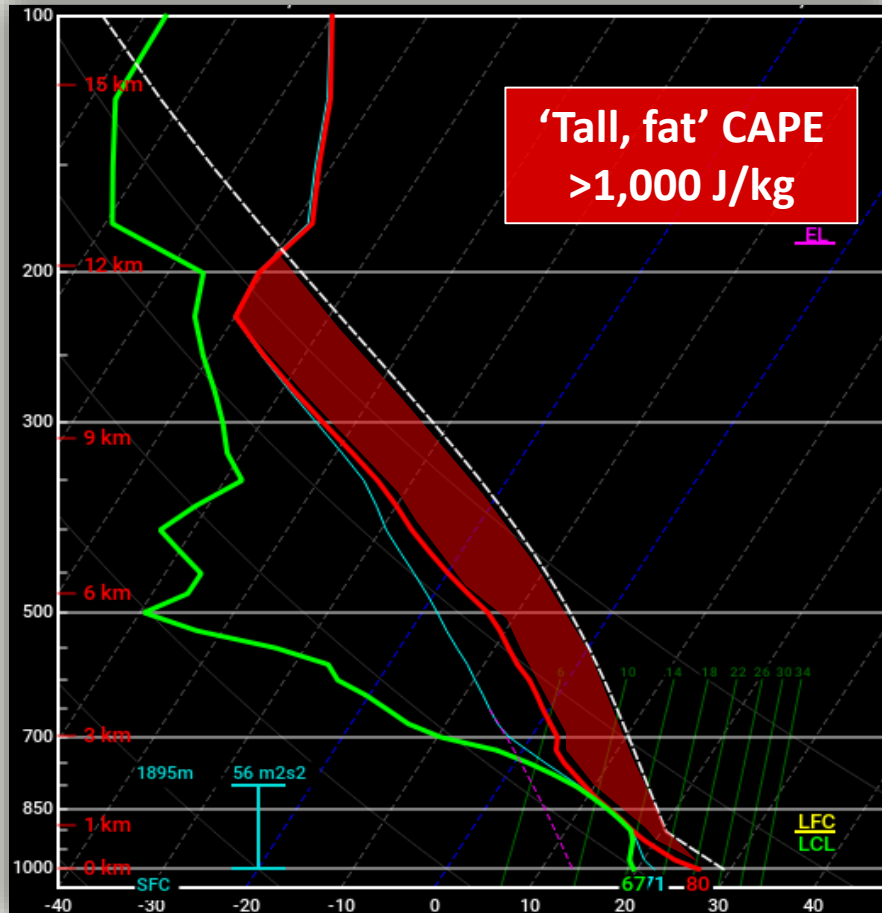


# The 3-Dimensional Atmosphere Instability

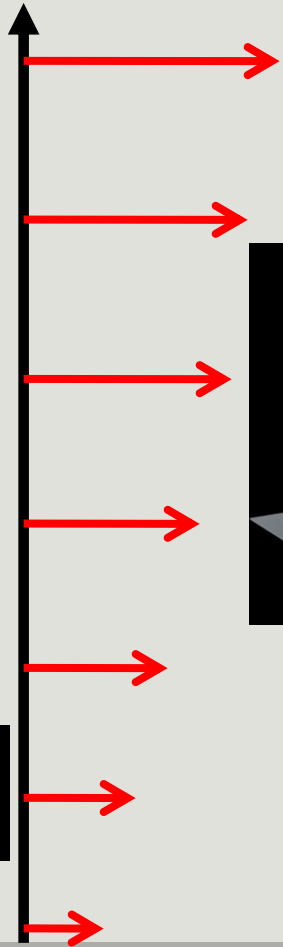
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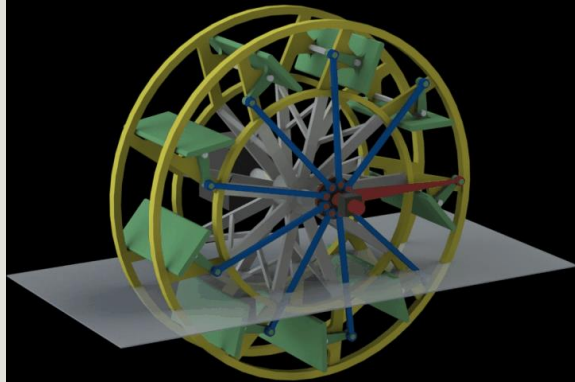
# Instability - Weak vs. Strong CAPE



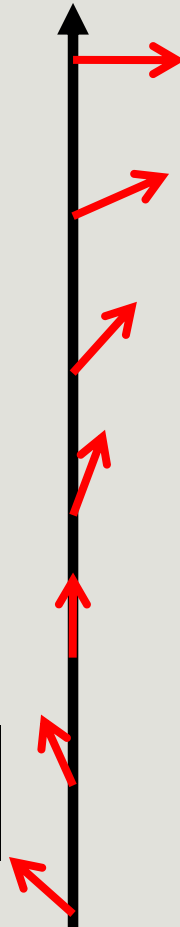
# Wind Shear



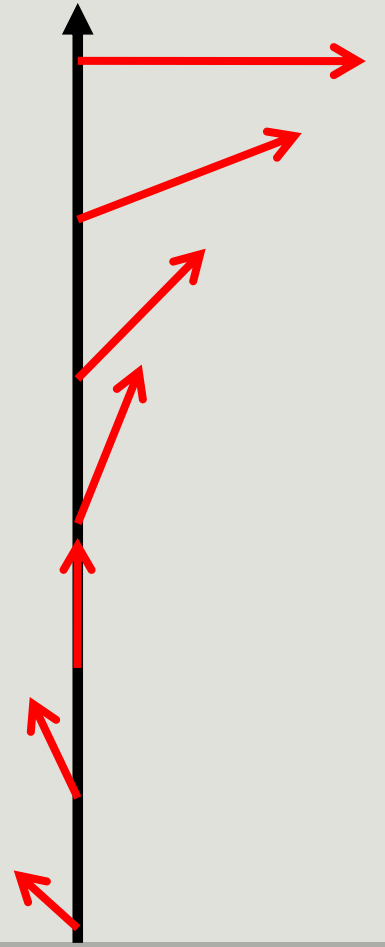
Change in wind speed with height



Change in wind direction with height



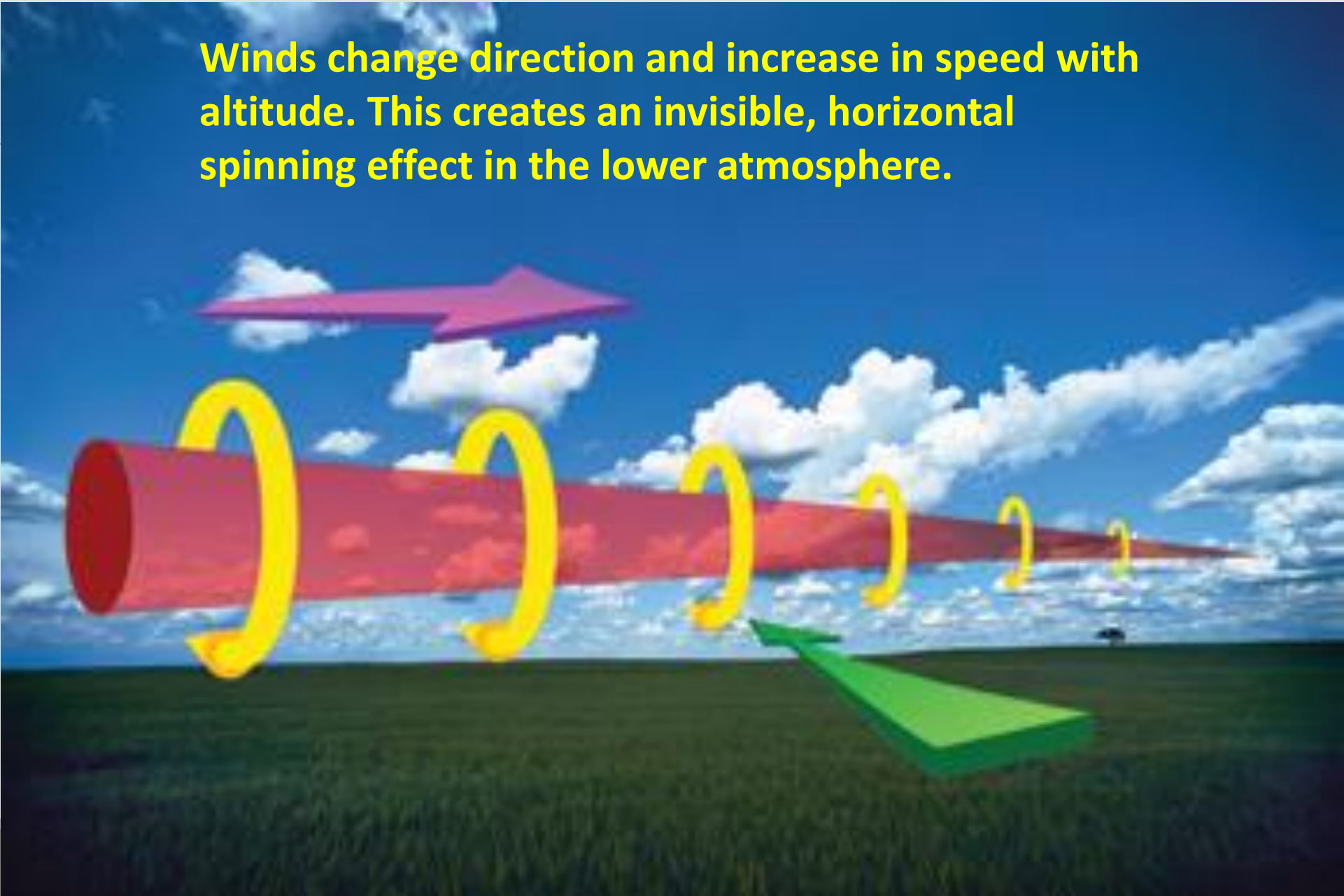
Change in wind speed and direction with height





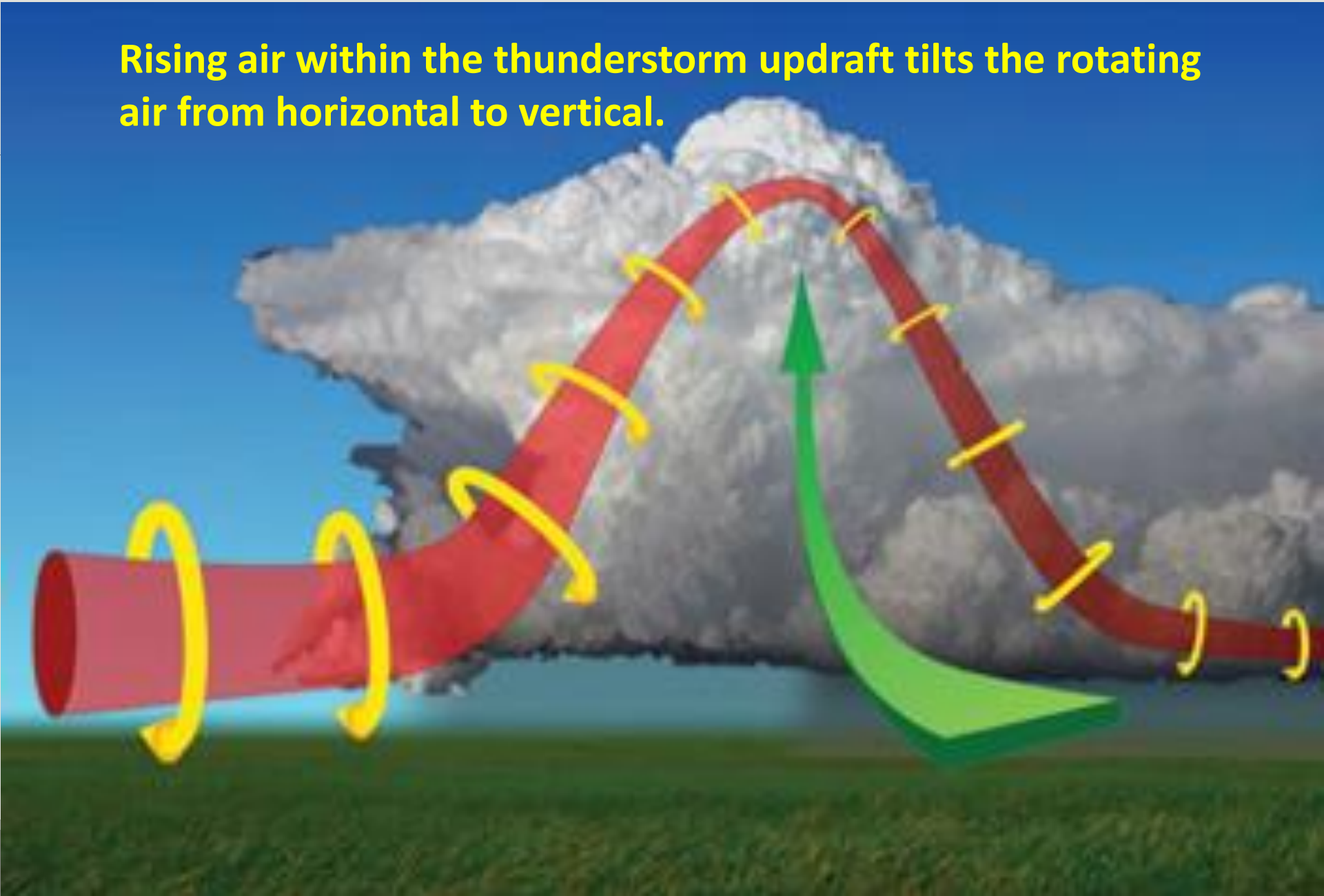
# Wind Shear

**Winds change direction and increase in speed with altitude. This creates an invisible, horizontal spinning effect in the lower atmosphere.**



# Wind Shear and Updraft

**Rising air within the thunderstorm updraft tilts the rotating air from horizontal to vertical.**



# Mesocyclone Formation

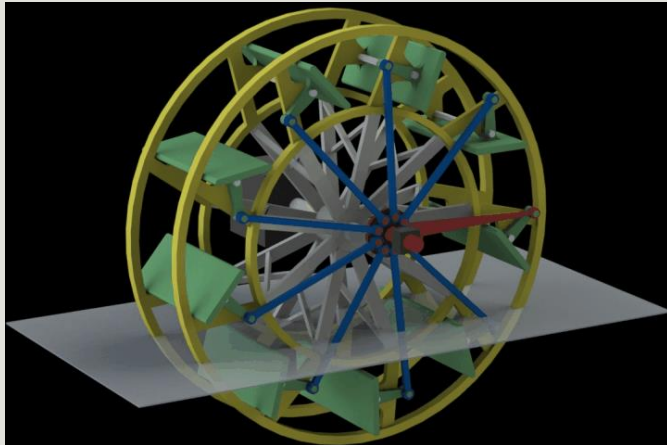
A mesocyclone, an area of rotation 2-6 miles wide, now extends through much of the storm.



# Bulk Shear

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- Difference in wind vectors (speed + direction) between 2 levels.
- >35 kts of bulk shear between the surface and 6 km above the surface means supercells can form.
  - *(if there is instability, lift, and moisture)*
- Wind shear between the surface and 3 km and surface and 1 km also important.





# Storm Relative Helicity

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- Potential for updraft rotation
- Required for corkscrew/helix-shaped flow



# Storm Relative Helicity

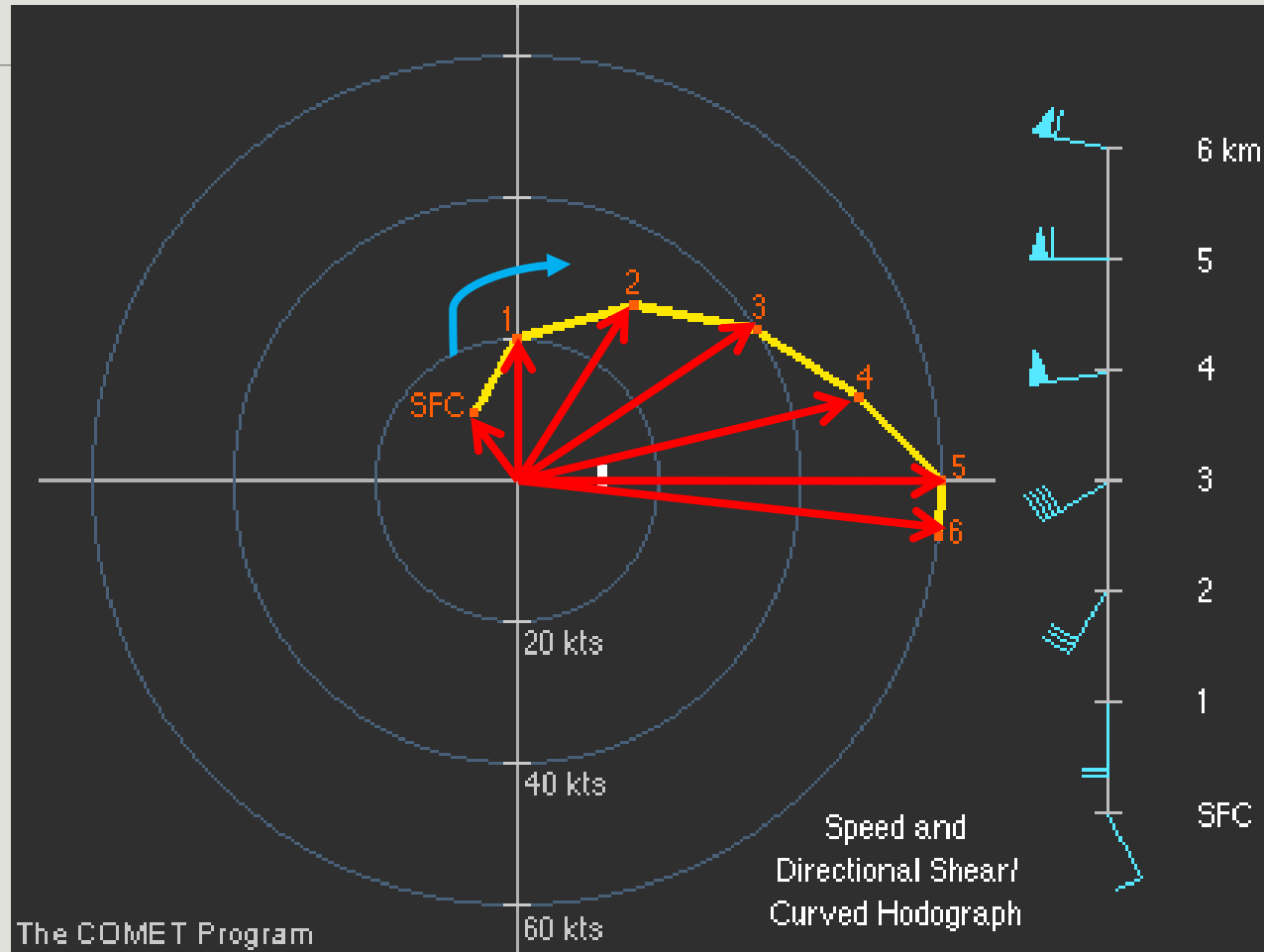
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Indicator of streamwise vorticity (spin): football spiral

Instead of crosswise vorticity: frisbee



# Storm-Relative Helicity



Observed via a hodograph

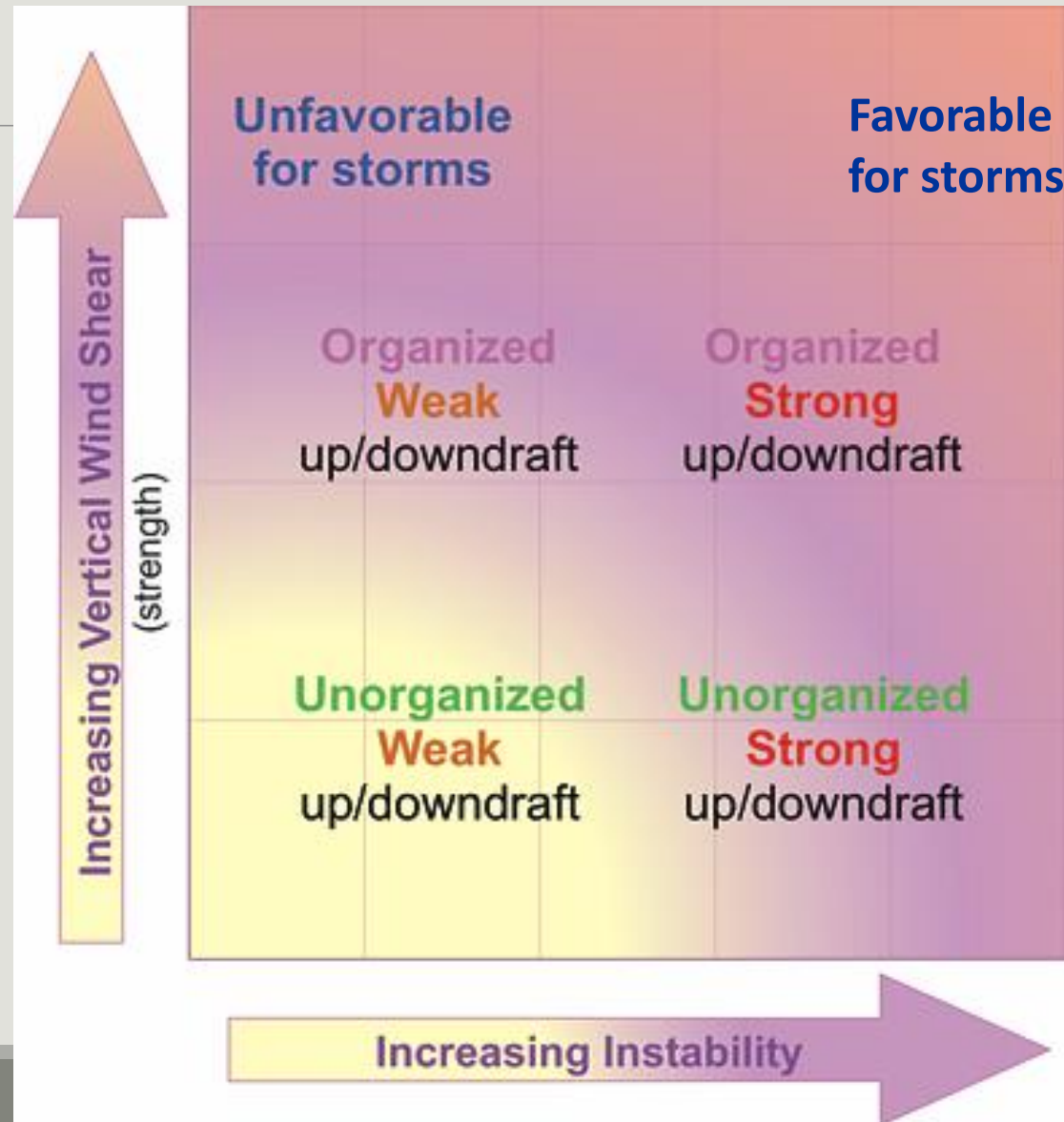
Wind vectors (length based on speed) drawn at multiple heights

Hodograph connects the tips of these vectors

Look for long hodograph (deep layer shear) and curved shape at low-levels (typically the left side)

# Finding the Perfect Balance

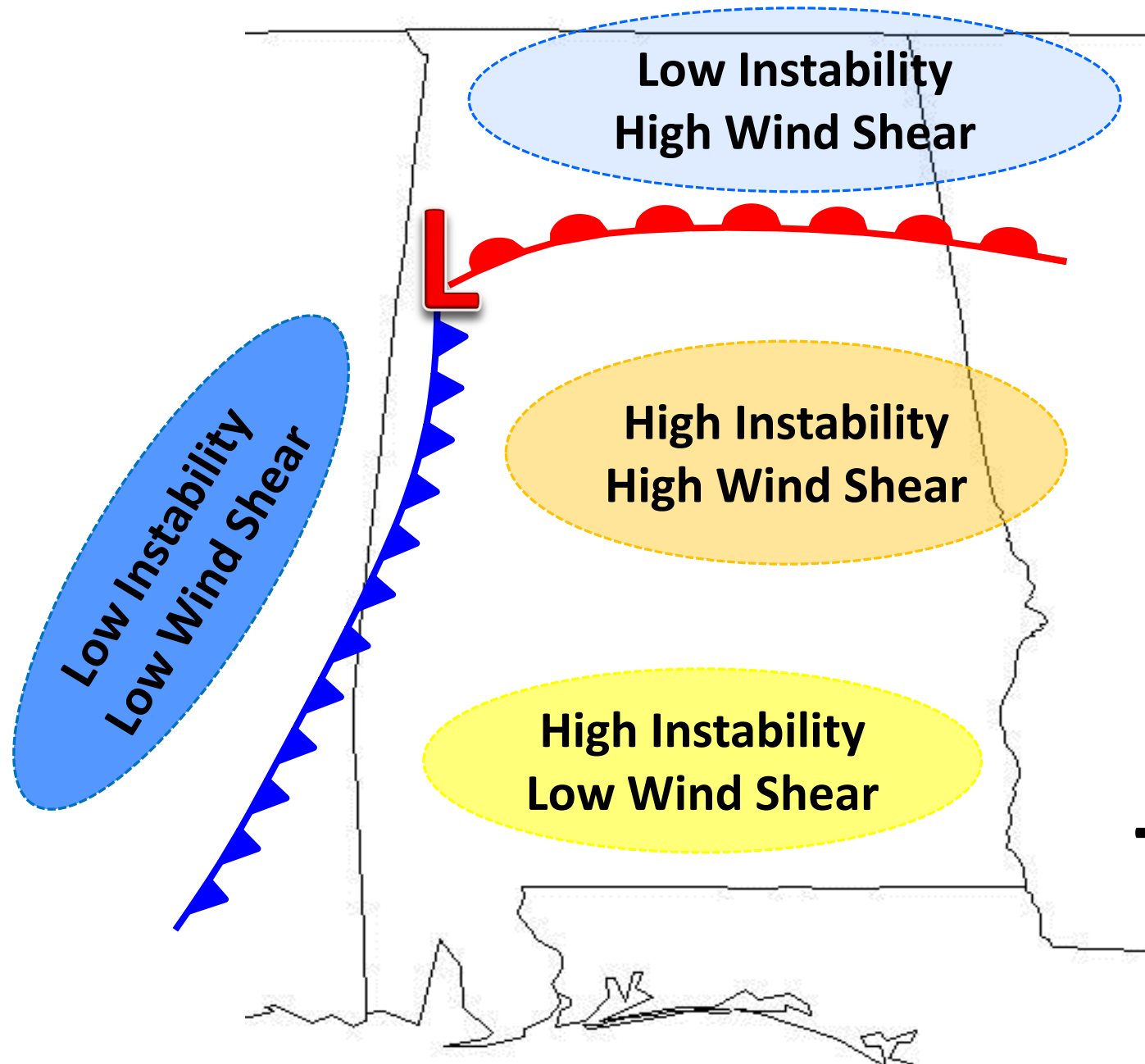
## Instability versus Wind Shear



Finding the perfect balance between instability and wind shear remains a forecast challenge.

All about the favorable **mode of convection**.





**Typical surface  
low setup.**

# Lifting Condensation Level (LCL)

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- Measure of height of cloud base
- Function of near-ground humidity—related to temperature-dew point difference
- Lower LCL = less humid environment = downdraft temperature won't be as cool relative to environment compared to if the LCL was high



Low LCL: favorable for tornadoes



High LCL: favorable for straight-line winds

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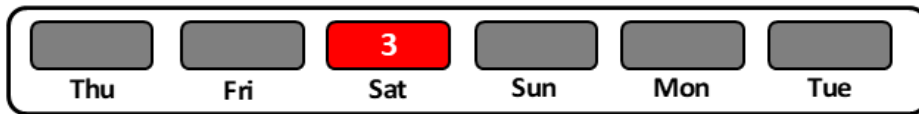
- Basic course recap
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# National Weather Service Birmingham Hazardous Weather Outlook

ISSUED: 4:29 PM Wednesday, April 3, 2019

EXPIRES: 6:30 AM Thursday

- Tropical
- Tornado
- Severe Storms
- Wind
- Heat/Cold
- Flood
- Fog
- Fire
- Winter Weather
- No Hazards



Confidence Factor :



# weather.gov/bmx

Hazardous Weather Outlook  
National Weather Service Birmingham AL  
311 AM CDT Wed Apr 3 2019

ALZ011>015-017>050-041115-  
Marion-Lamar-Fayette-Winston-Walker-Blount-Etowah-Calhoun-Cherokee-  
Cleburne-Pickens-Tuscaloosa-Jefferson-Shelby-St. Clair-Talladega-  
Clay-Randolph-Sumter-Greene-Hale-Perry-Bibb-Chilton-Coosa-Tallapoosa-  
Chambers-Marengo-Dallas-Autauga-Lowndes-Elmore-Montgomery-Macon-  
Bullock-Lee-Russell-Pike-Barbour-  
311 AM CDT Wed Apr 3 2019

This Hazardous Weather Outlook is for the counties served by the  
National Weather Service office in Birmingham.

.DAY ONE...Outlook through Tonight.

No hazardous weather is expected at this time.

.DAYS TWO THROUGH SEVEN...Thursday through Tuesday.

No hazardous weather is expected at this time.

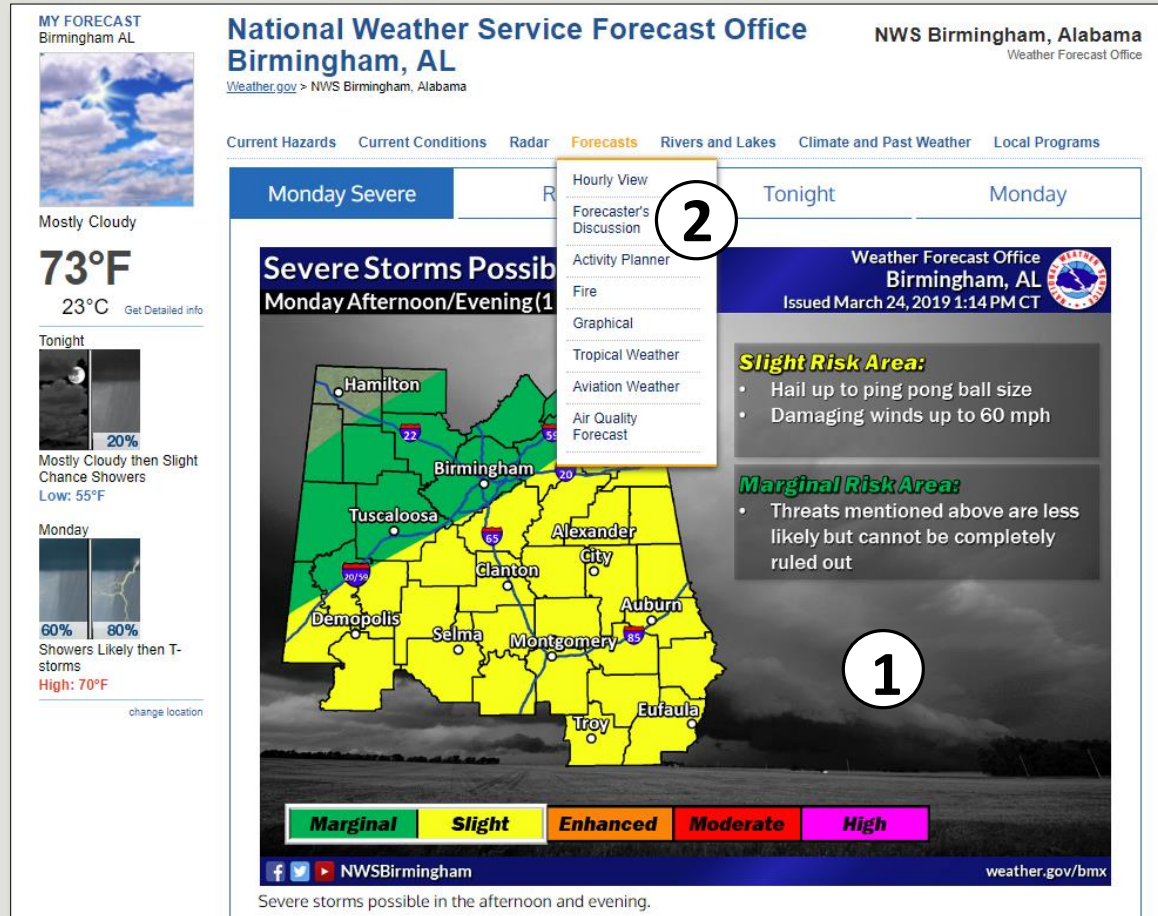
SPOTTER INFORMATION STATEMENT...

Activation of storm spotters and emergency management is not  
expected at this time.

\$\$



# weather.gov/bmx



2

--Slight Risk of severe storms Monday afternoon to evening w/ large hail and damaging wind potential--

A shortwave trough will move from the Midwest toward the Central Appalachian region on Monday while a secondary shortwave trough moves from the Southern Plains into the Southeastern CONUS. The secondary trough will be the primary factor in Monday's severe threat.

The primary forecast complication is with respect to upstream precipitation that is forecast to move into the northwestern part of the forecast area early morning Monday. It appears that this activity should begin weakening as it continues eastward, setting the stage for a lingering boundary/differential heating zone. As the secondary impulse arrives during ensuing daytime heating, we'll be looking at an increasingly unstable air mass with support for renewed convection. Pending this scenario, strong to severe storms could occur during the afternoon and evening hours.

Surface flow ahead of the associated cold front won't be ideal for rapid or significant recovery/advection of higher-dew point air, though guidance continues to agree with a corridor of upper 50s to around 60 dews arriving by/into the afternoon hours. This will coincide with peak daytime heating, aiding in ample surface-based and mixed-layer CAPE for strong to severe convection given bulk shear of ~40-50 knots. A look at forecast soundings across Central Alabama show a low-level inverted-V profile with steep lapse rates. This will support a risk of damaging winds up to 60 MPH. A plume of mid-level dry air moving into the base of the trough + some overlap of the convective area and leading edge colder 500mb temperatures will supply mid-level lapse rates in the mid-upper 6 degrees C range. This will support a risk of severe-caliber hail. Given the unidirectional flow, a tornado threat isn't evident at this time. Due to limited vertical moisture content and surface convergence, we shouldn't see a high number of severe-caliber storms.

# Types of Tornado Warnings

BULLETIN - EAS ACTIVATION REQUESTED  
Tornado Warning  
National Weather Service Birmingham AL  
158 PM CST SUN MAR 3 2019

The National Weather Service in Birmingham has issued a

\* Tornado Warning for...  
Central Lee County in east central Alabama...  
Northwestern Russell County in southeastern Alabama...

\* Until 245 PM CST.

\* At 158 PM CST, a severe thunderstorm capable of producing a tornado was located near Tuskegee National Forest, or 9 miles south of Auburn, moving east at 60 mph.

HAZARD...Tornado.

SOURCE...Radar indicated rotation.

IMPACT...Flying debris will be dangerous to those caught without shelter. Mobile homes will be damaged or destroyed. Damage to roofs, windows, and vehicles will occur. Tree damage is likely.

\* Locations impacted include...  
Auburn, Phenix City, Opelika, Smiths, Smiths Station, Ladonia, Beauregard, Bleecker, Griffen Mill, Bibb City, Monterey Heights, Chewacla State Park, Ladonia Sports Complex, Marvyn and Bartlett's Ferry Dam.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

TAKE COVER NOW! Move to a basement or an interior room on the lowest floor of a sturdy building. Avoid windows. If you are outdoors, in a mobile home, or in a vehicle, move to the closest substantial shelter and protect yourself from flying debris.

&&

LAT...LON 3239 8544 3250 8544 3250 8549 3253 8556  
3268 8511 3267 8509 3265 8509 3265 8511  
3263 8508 3262 8509 3258 8507 3251 8500  
3249 8499 3247 8500 3245 8499

TIME...MOT...LOC 1958Z 252DEG 53KT 3246 8552

TORNADO...RADAR INDICATED

HAIL...<.75IN

\$\$

Severe Weather Statement  
National Weather Service Birmingham AL  
207 PM CST SUN MAR 3 2019

ALC081-113-032045-  
/O.CON.KBMX.TO.W.0023.000000T0000Z-190303T2045Z/  
Lee AL-Russell AL-  
207 PM CST SUN MAR 3 2019

...A TORNADO WARNING REMAINS IN EFFECT UNTIL 245 PM CST FOR CENTRAL LEE AND NORTHWESTERN RUSSELL COUNTIES...

At 206 PM CST, a confirmed large and extremely dangerous tornado was located near Society Hill, or 10 miles southeast of Auburn, moving east at 55 mph.

This is a PARTICULARLY DANGEROUS SITUATION. TAKE COVER NOW!

HAZARD...Damaging tornado.

SOURCE...Radar confirmed tornado.

IMPACT...You are in a life-threatening situation. Flying debris may be deadly to those caught without shelter. Mobile homes will be destroyed. Considerable damage to homes, businesses, and vehicles is likely and complete destruction is possible.

Locations impacted include...  
Auburn, Phenix City, Opelika, Smiths, Smiths Station, Ladonia, Beauregard, Bleecker, Griffen Mill, Bibb City, Monterey Heights, Chewacla State Park, Ladonia Sports Complex, Marvyn and Bartlett's Ferry Dam.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

To repeat, a large, extremely dangerous and potentially deadly tornado is on the ground. To protect your life, TAKE COVER NOW! Move to a basement or an interior room on the lowest floor of a sturdy building. Avoid windows. If you are outdoors, in a mobile home, or in a vehicle, move to the closest substantial shelter and protect yourself from flying debris.

&&

LAT...LON 3239 8544 3250 8544 3250 8549 3253 8556  
3268 8511 3267 8509 3265 8509 3265 8511  
3263 8508 3262 8509 3258 8507 3251 8500  
3249 8499 3247 8500 3245 8499

TIME...MOT...LOC 2006Z 258DEG 48KT 3247 8538

TORNADO...OBSERVED  
TORNADO DAMAGE THREAT...CONSIDERABLE

HAIL...<.75IN

Severe Weather Statement  
National Weather Service Birmingham AL  
209 PM CST SUN MAR 3 2019

ALC081-113-032045-  
/O.CON.KBMX.TO.W.0023.000000T0000Z-190303T2045Z/  
Lee AL-Russell AL-  
209 PM CST SUN MAR 3 2019

...TORNADO EMERGENCY FOR southern Lee County and northern Russell County...

...A TORNADO WARNING REMAINS IN EFFECT UNTIL 245 PM CST FOR SOUTHEASTERN LEE AND NORTHWESTERN RUSSELL COUNTIES...

At 209 PM CST, a confirmed large and destructive tornado was located near Griffen Mill, or 11 miles southeast of Auburn, moving east at 60 mph.

TORNADO EMERGENCY for southern Lee County and northern Russell County. This is a PARTICULARLY DANGEROUS SITUATION. TAKE COVER NOW!

HAZARD...Deadly tornado.

SOURCE...Radar confirmed tornado.

IMPACT...You are in a life-threatening situation. Flying debris may be deadly to those caught without shelter. Mobile homes will be destroyed. Considerable damage to homes, businesses, and vehicles is likely and complete destruction is possible.

Locations impacted include...  
Phenix City, Smiths, Smiths Station, Ladonia, Bleecker, Griffen Mill, Bibb City, Monterey Heights, Ladonia Sports Complex, Marvyn and Bartlett's Ferry Dam.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

To repeat, a large, extremely dangerous, and potentially deadly tornado is on the ground. To protect your life, TAKE COVER NOW! Move to an interior room on the lowest floor of a sturdy building. Avoid windows. If in a mobile home, a vehicle or outdoors, move to the closest substantial shelter and protect yourself from flying debris.

&&

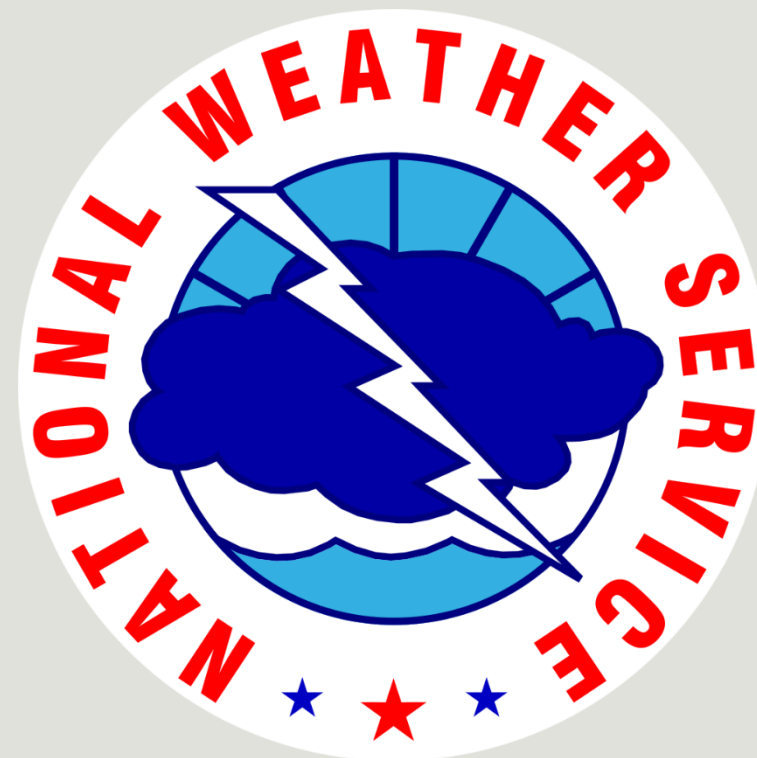
LAT...LON 3242 8540 3250 8544 3268 8511 3267 8509  
3265 8509 3265 8511 3263 8508 3262 8509  
3258 8507 3251 8500 3249 8499 3247 8500  
3245 8499

TIME...MOT...LOC 2009Z 252DEG 53KT 3248 8533

TORNADO...OBSERVED  
TORNADO DAMAGE THREAT...CATASTROPHIC

HAIL...<.75IN

# Halftime! 10-minute Break



# Advanced Spotter Training Outline



## Part I

- Atmospheric features, types and scale
- Severe weather ingredients
- Using our products
- Basic course recap



## Part II

- RADAR signatures
- Tornadogenesis
- Demo a severe weather event



# What Makes a Storm Severe?

---

## **SEVERE THUNDERSTORM WARNING** POTENTIAL OF \_\_ OCCURRING, OR OBSERVED

- Wind gusts of 58 mph or greater, and/or
- Hail 1 inch or more in diameter



## **TORNADO WARNING** POTENTIAL OF \_\_ OCCURRING, OR OBSERVED

- A tornado
  - Tornadic storms can also produce damaging straight-line winds and large hail



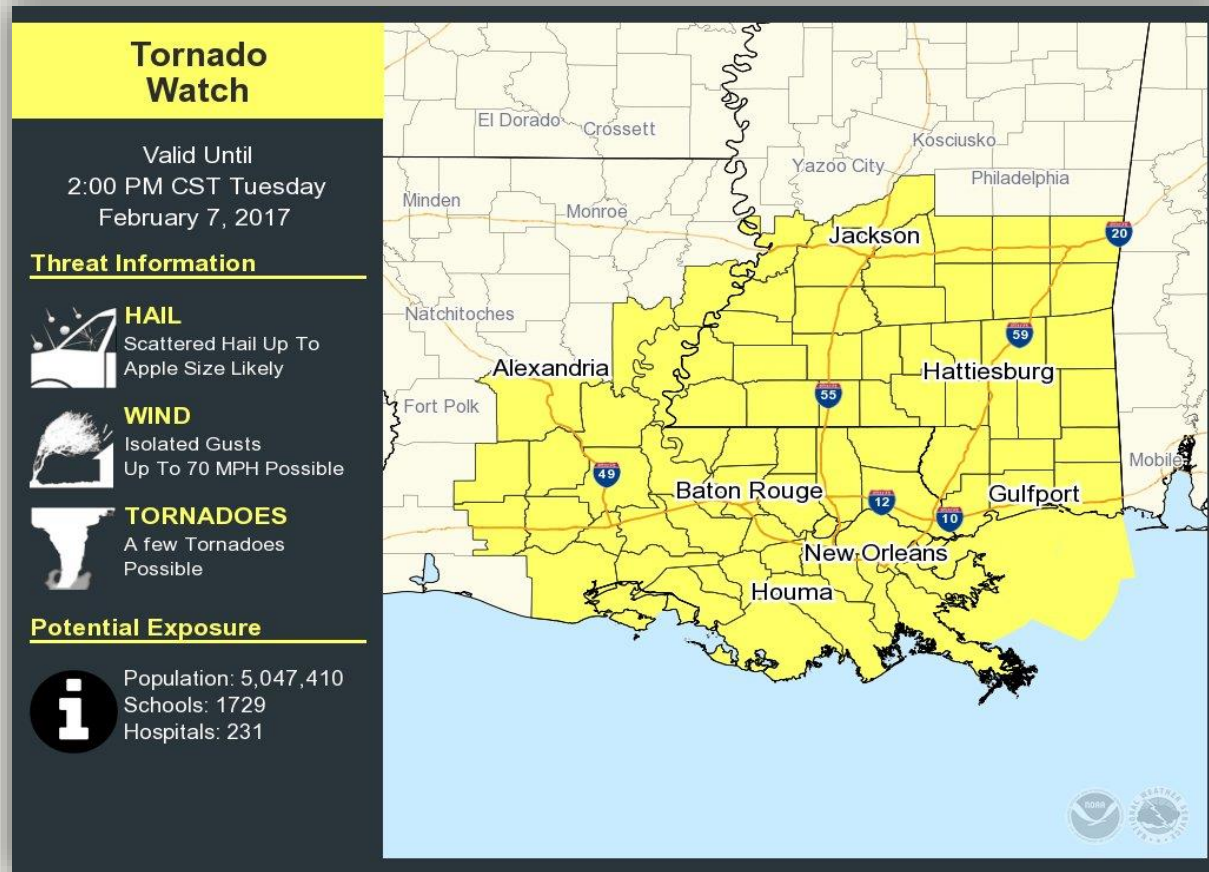
# Understanding Severe Thunderstorm Risk Categories

THUNDERSTORMS (no label)	1 - MARGINAL (MRGL)	2 - SLIGHT (SLGT)	3 - ENHANCED (ENH)	4 - MODERATE (MDT)	5 - HIGH (HIGH)
<b>No severe* thunderstorms expected</b>	<b>Isolated severe thunderstorms possible</b>	<b>Scattered severe storms possible</b>	<b>Numerous severe storms possible</b>	<b>Widespread severe storms likely</b>	<b>Widespread severe storms expected</b>
Lightning/flooding threats exist with <u>all</u> thunderstorms	Limited in duration and/or coverage and/or intensity	Short-lived and/or not widespread, isolated intense storms possible	More persistent and/or widespread, a few intense	Long-lived, widespread and intense	Long-lived, very widespread and particularly intense
					
<ul style="list-style-type: none"> <li>• Winds to 40 mph</li> <li>• Small hail</li> </ul>	<ul style="list-style-type: none"> <li>• Winds 40-60 mph</li> <li>• Hail up to 1"</li> <li>• Low tornado risk</li> </ul>	<ul style="list-style-type: none"> <li>• One or two tornadoes</li> <li>• Reports of strong winds/wind damage</li> <li>• Hail ~1", isolated 2"</li> </ul>	<ul style="list-style-type: none"> <li>• A few tornadoes</li> <li>• Several reports of wind damage</li> <li>• Damaging hail, 1 - 2"</li> </ul>	<ul style="list-style-type: none"> <li>• Strong tornadoes</li> <li>• Widespread wind damage</li> <li>• Destructive hail, 2" +</li> </ul>	<ul style="list-style-type: none"> <li>• Tornado outbreak</li> <li>• Derecho</li> </ul>

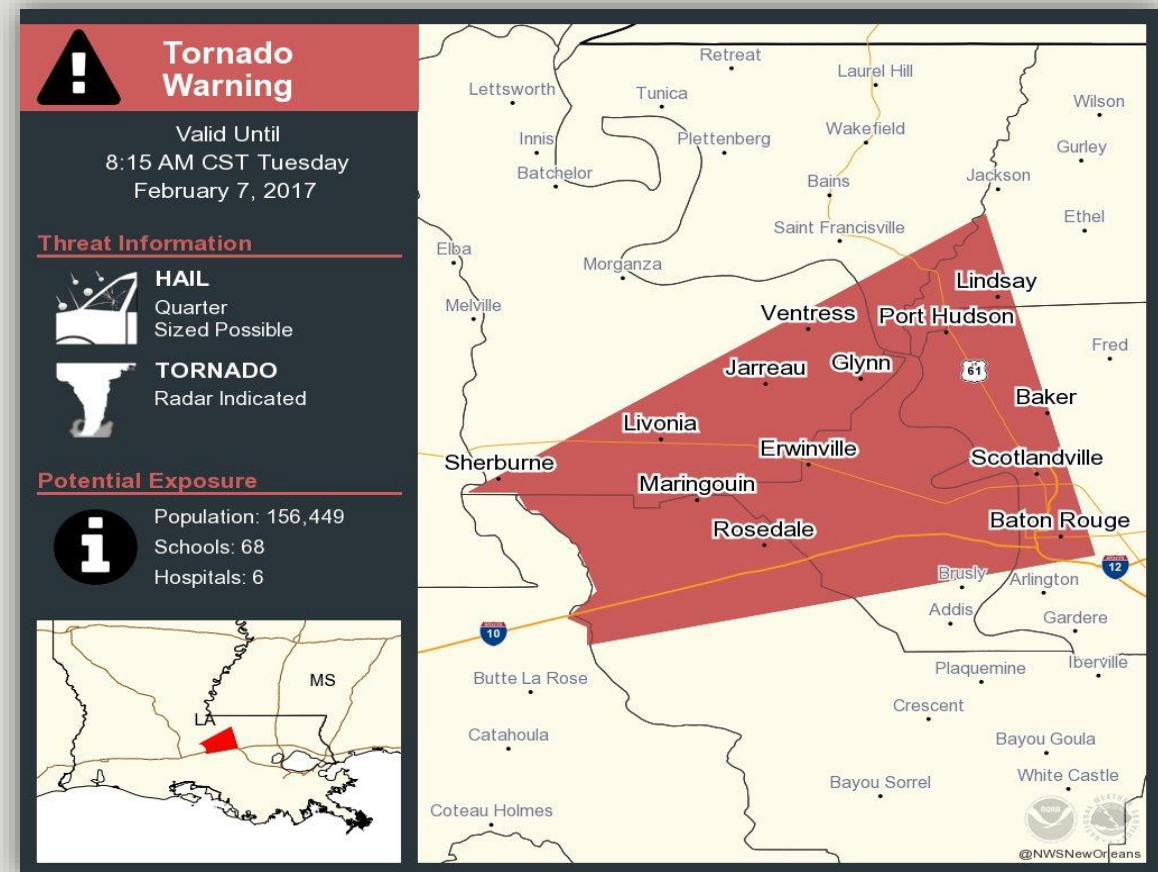
\* NWS defines a severe thunderstorm as measured wind gusts to at least 58 mph, and/or hail to at least one inch in diameter, and/or a tornado. All thunderstorm categories imply lightning and the potential for flooding. Categories are also tied to the probability of a severe weather event within 25 miles of your location.



# Watch vs. Warning



**WATCHES:** Conditions are favorable for severe weather to develop; cover large areas and last several hours. *BE AWARE & PREPARED!*



**WARNINGS:** Severe weather is very likely soon or is occurring; cover smaller areas and last an hour or less. *TAKE ACTION!*

# What to Report

## --Strong or Damaging Wind--



**Estimating wind speed is difficult.** It will be much easier to describe damage. If you report a speed, let us know if it was estimated or measured.

- ☁️ Trees or large limbs blown down
  - Snapped or uprooted
  - Were the trees or limbs dead or alive
- ☁️ Power poles downed
- ☁️ Damage to buildings



# What to Report

## --Hail--

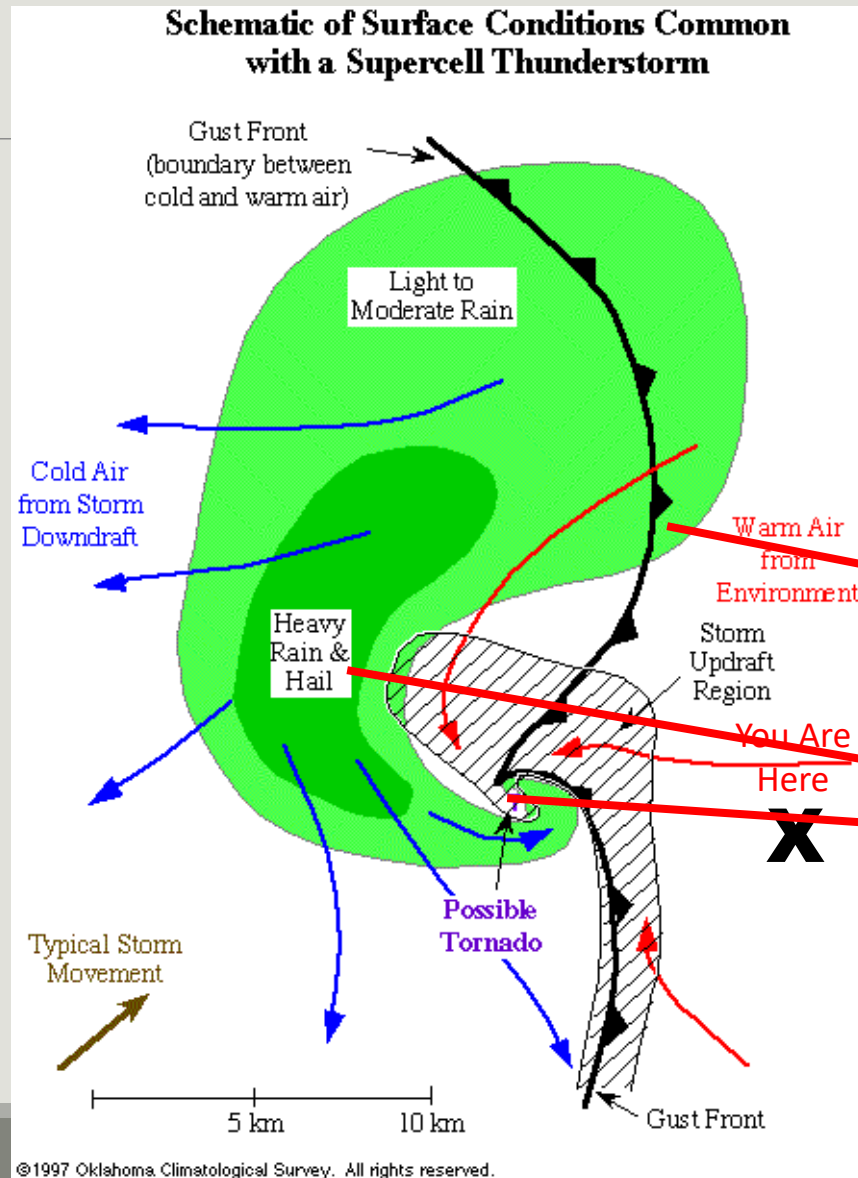


Report the size of the largest hail stone you see. ***Please do not report “marble-sized hail.”***

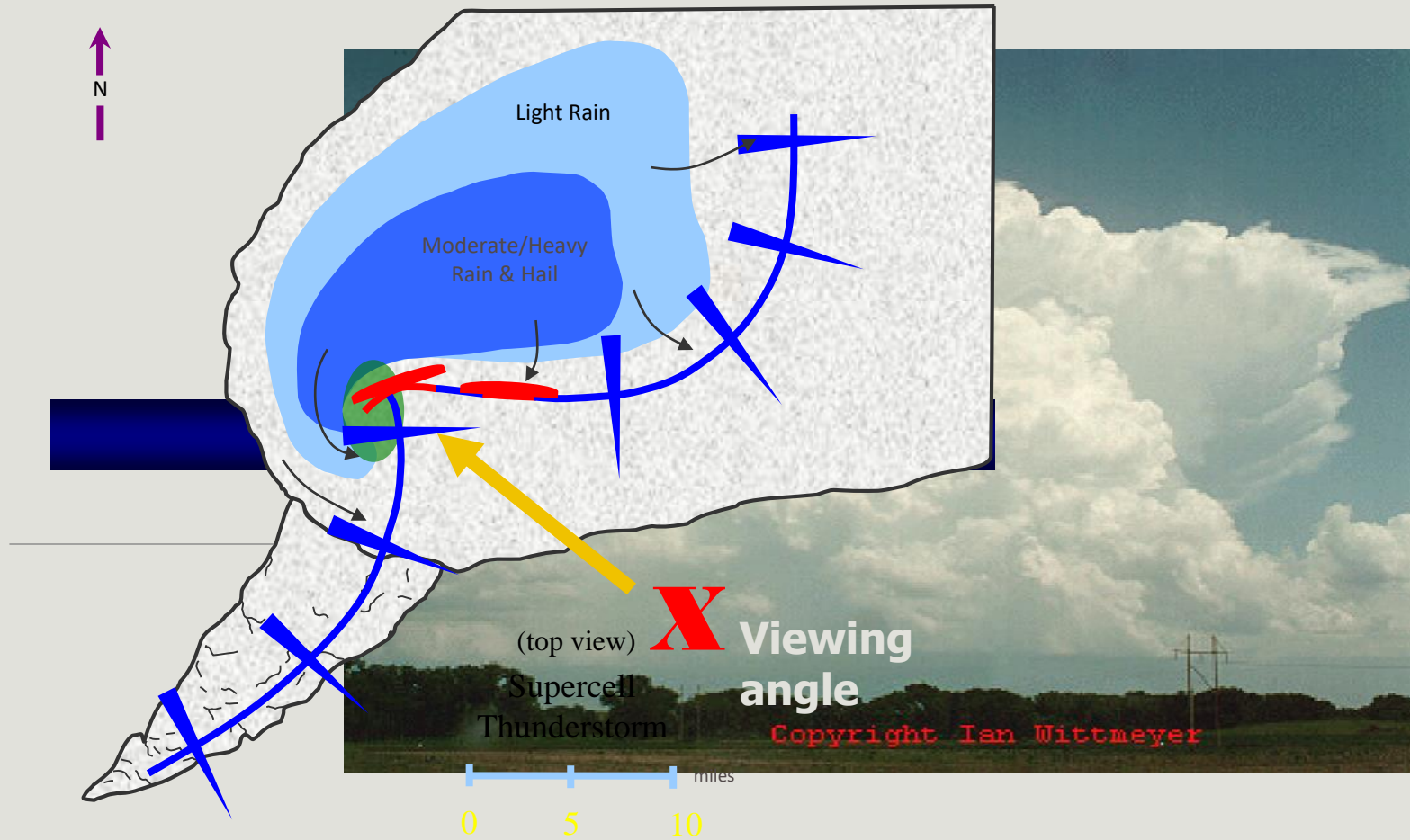


- ☁️ Measure with a ruler or caliper
- ☁️ Reference a common item
  - Coins (quarter, half-dollar, etc.)
  - Sporting equipment (golf ball, tennis ball, etc.)
- ☁️ Did the hail cause damage?

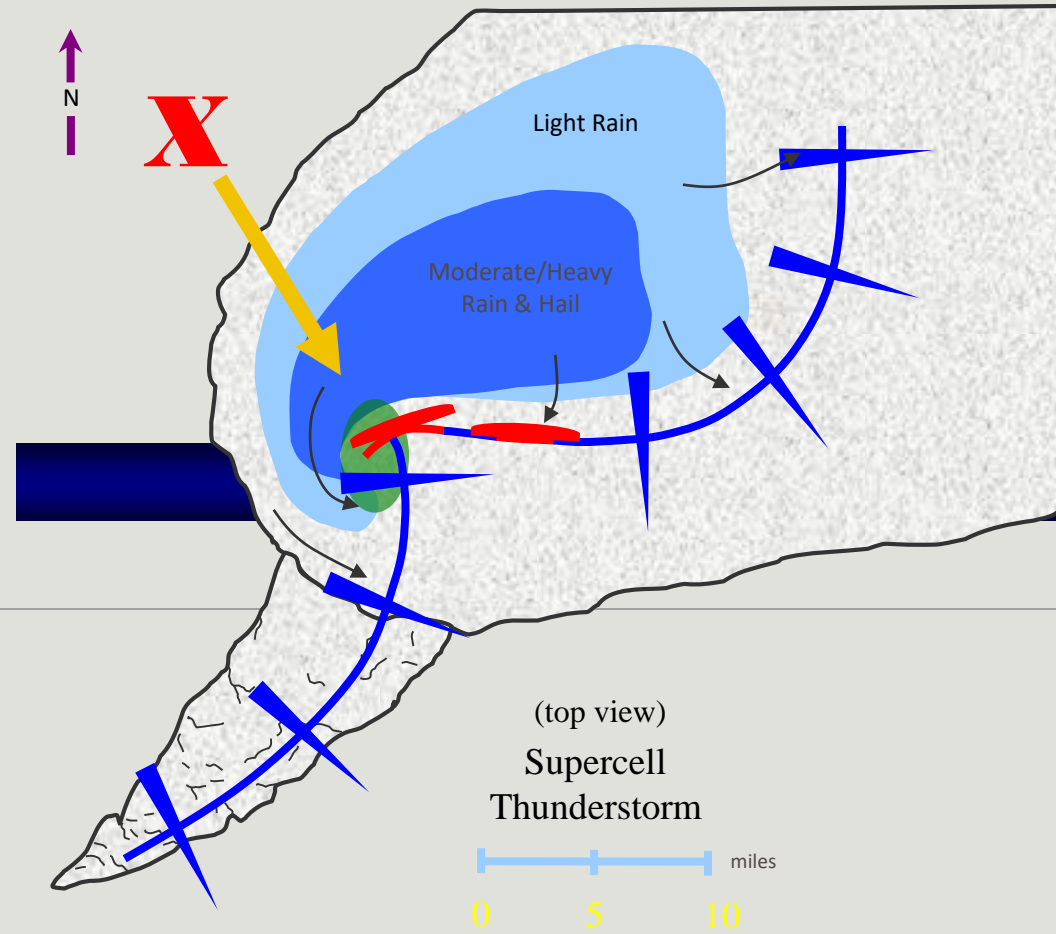
# What We Observe When Spotting Supercell



# Spotter Location



# NOT Ideal Spotter Location





# Wall Cloud -> Tornado Evolution

---

**Wall Cloud**



**Funnel Cloud**



**Tornado**



# Reporting Options Recap

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- Call the NWS office: 205-664-3010, option 2
- Social media: Twitter and Facebook
- Spotter Network
- HAM radio
- Our webpage: [weather.gov/bmx](https://weather.gov/bmx) -> Submit a Storm Report page
- After-the-event reports: [sr-bmx.dss@noaa.gov](mailto:sr-bmx.dss@noaa.gov)
  - Don't use e-mail for urgent reports



# Advanced Spotter Training Outline

*--Disclaimer: This is Not Storm Chaser Training--*



## Part I

- Atmospheric features, types and scale
- Severe weather ingredients
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## Part II

- Basic course recap
- RADAR signatures
- Tornadogenesis
- Demo a severe weather event





Velocity: Green =  
winds towards the  
radar

Red = winds away  
from the radar

Rotation!



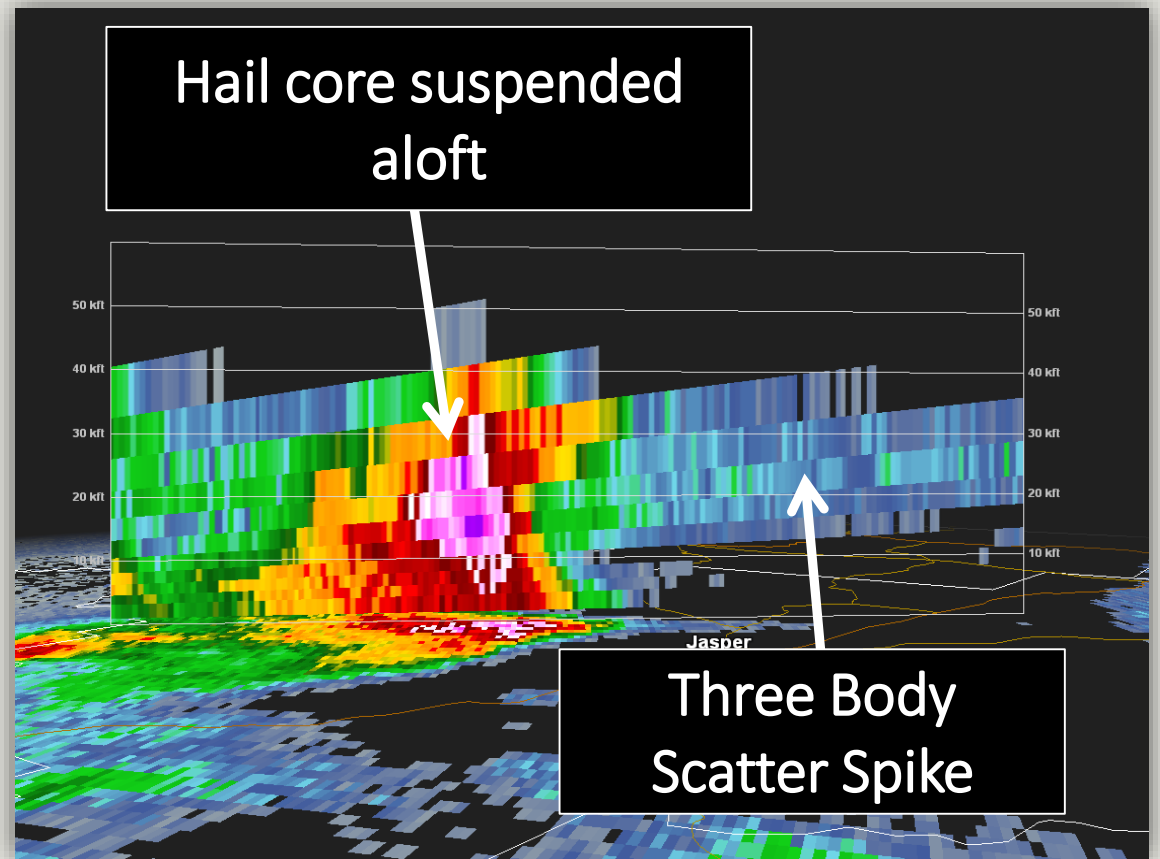
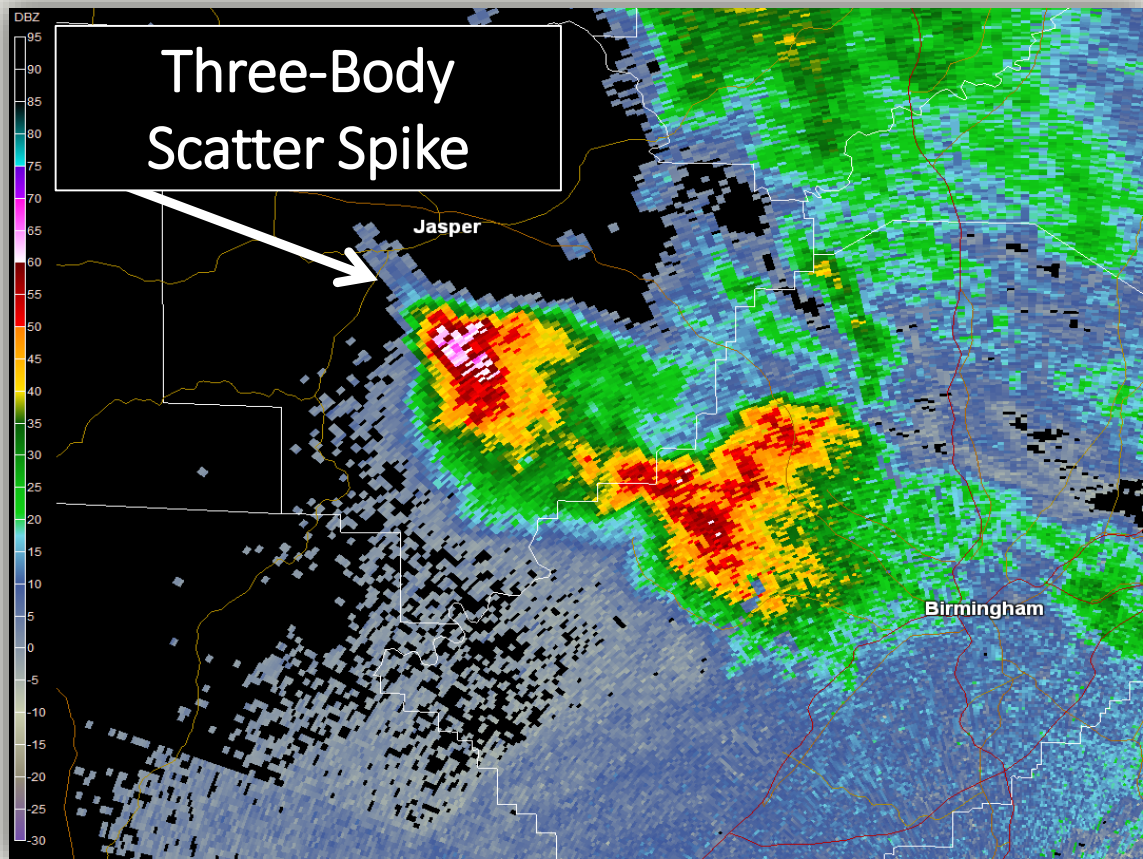
Straight-line winds

Watch for inflections  
along the line!

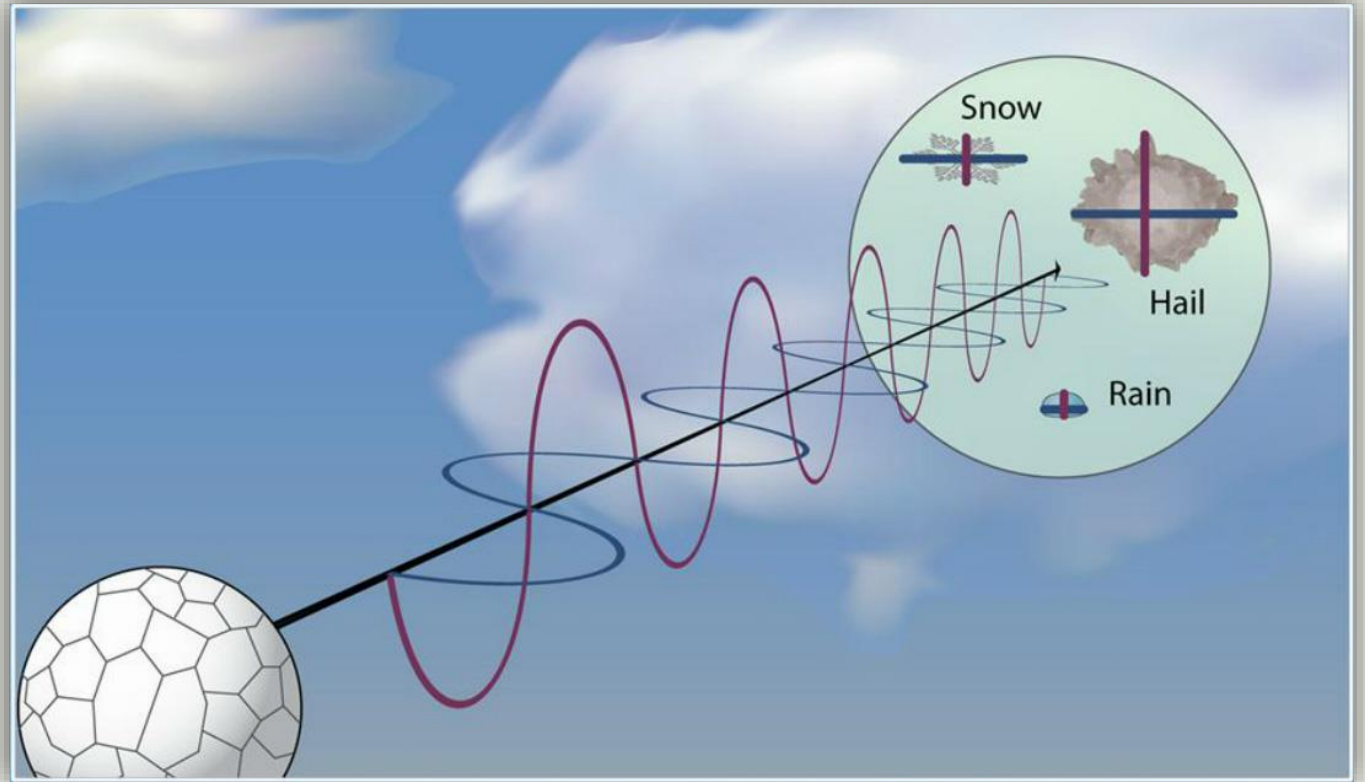
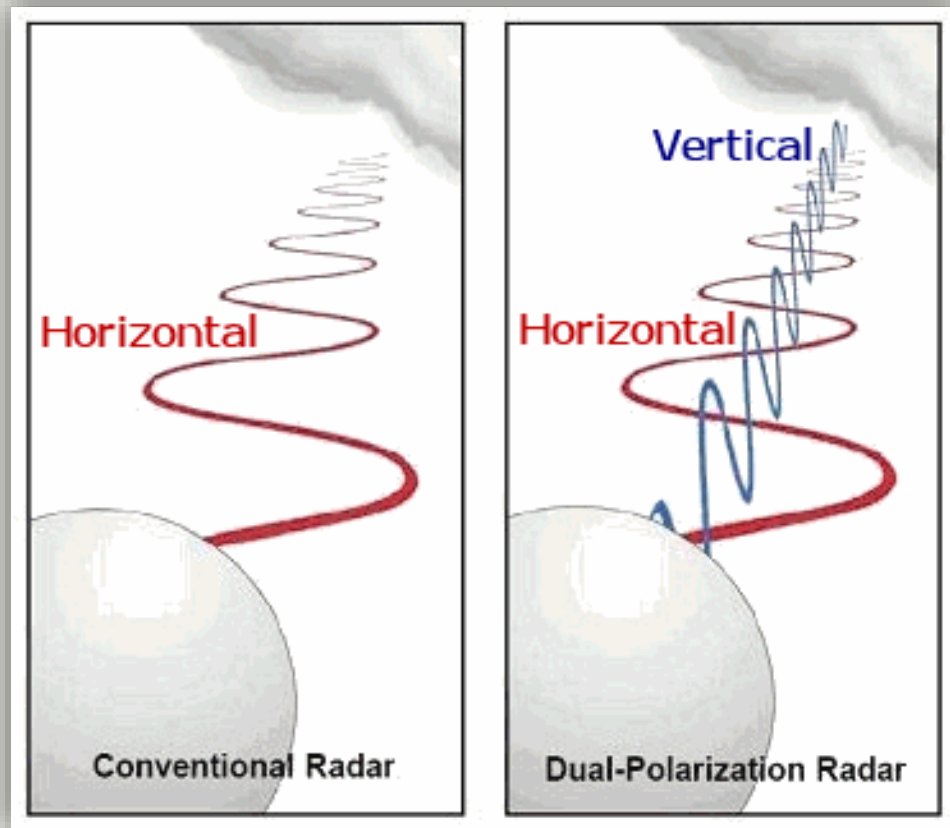




# Three Body Scatter Spike > Large Hail

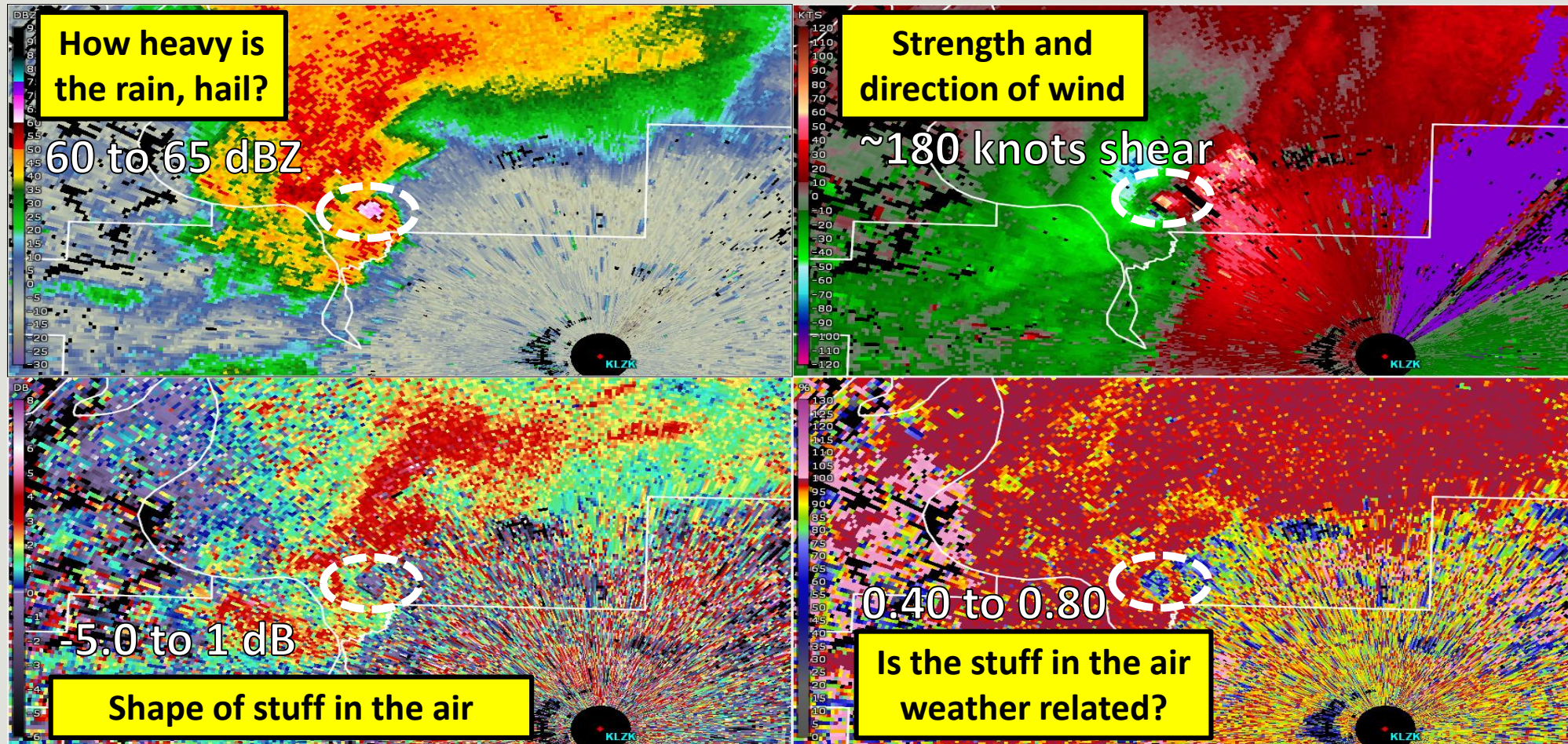


# Dual-polarization Radar





# Confirming Tornado Debris on RADAR



# BEWARE: Not all 'Blue' on CC is Tornado Debris!

--This takes a trained eye--

---

It could be...

- Contaminants in the inflow region
- Hail
- Noise in the data
- Non-uniform beam filling
- Terrain, communication towers, buildings, wind farms, etc.

**At minimum we must use a combination of reflectivity, velocity, and CC + RADAR scans over time and depth.**



# Advanced Spotter Training Outline

*--Disclaimer: This is Not Storm Chaser Training--*



## Part I

- Atmospheric features, types and scale
- Severe weather ingredients
- Using our products

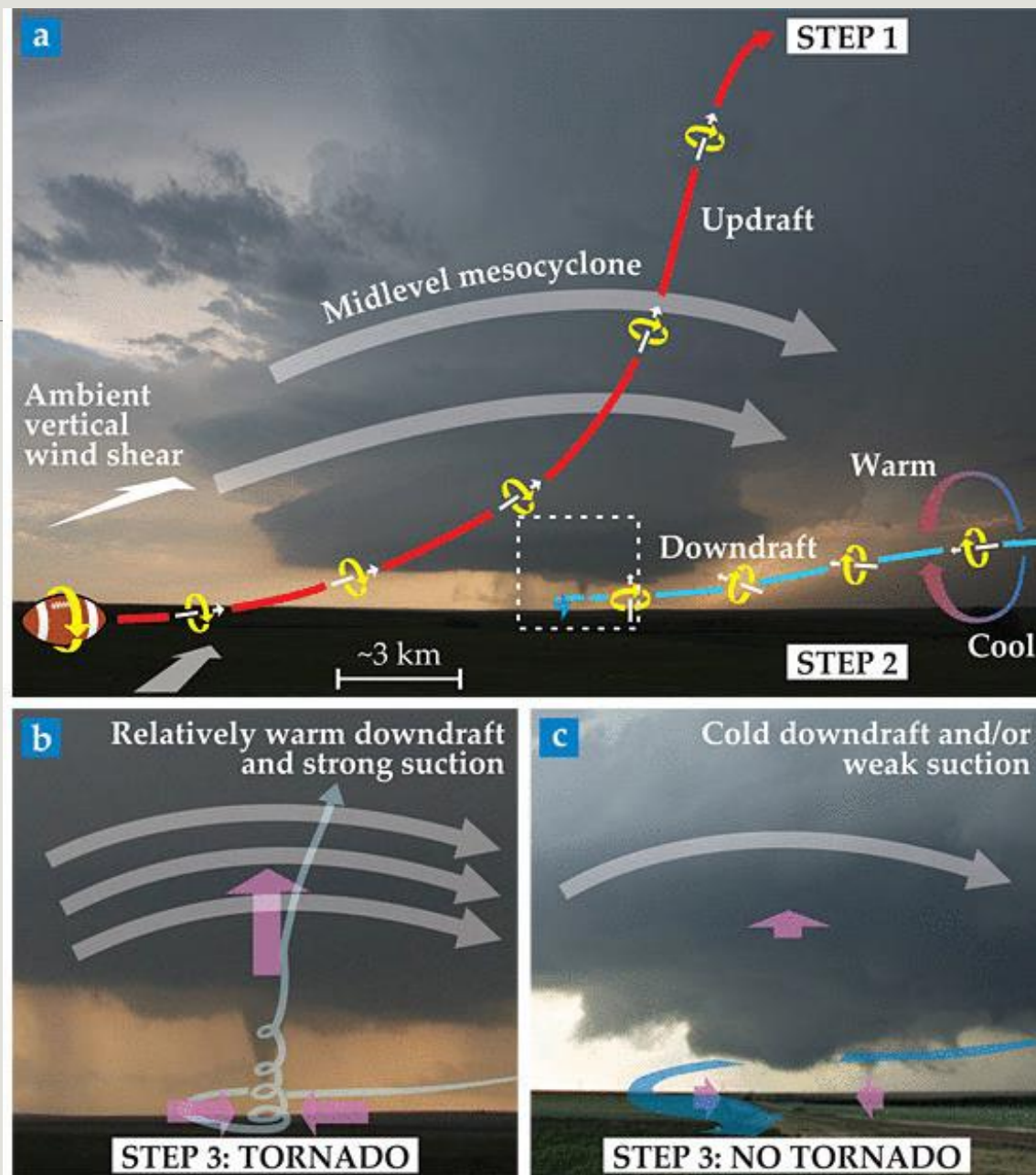
## Part II

- Basic course recap
- RADAR signatures
- Tornadogenesis
- Demo a severe weather event





Markowski and  
Richardson 2014



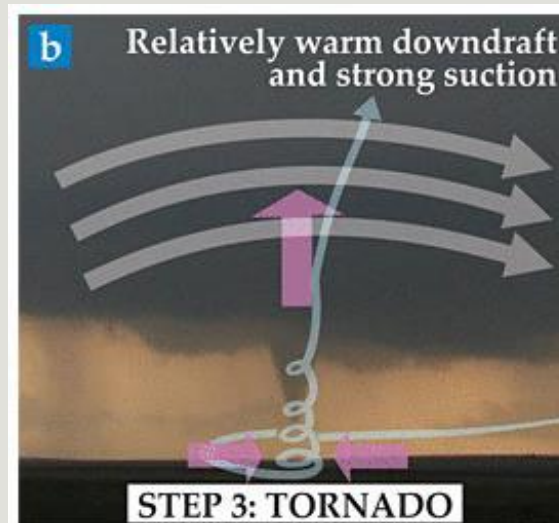
# Tornado pet peeves

---

Tornadoes do not actually “touch down” and “lift”, they “spin up” and “dissipate”.

“The tornado was up in the tree tops but not on the ground”

- Weakest part of the tree is the top



# Advanced Spotter Training Outline

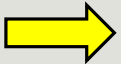


## Part I

- Atmospheric features, types and scale
- Severe weather ingredients
- Using our products
- Basic course recap

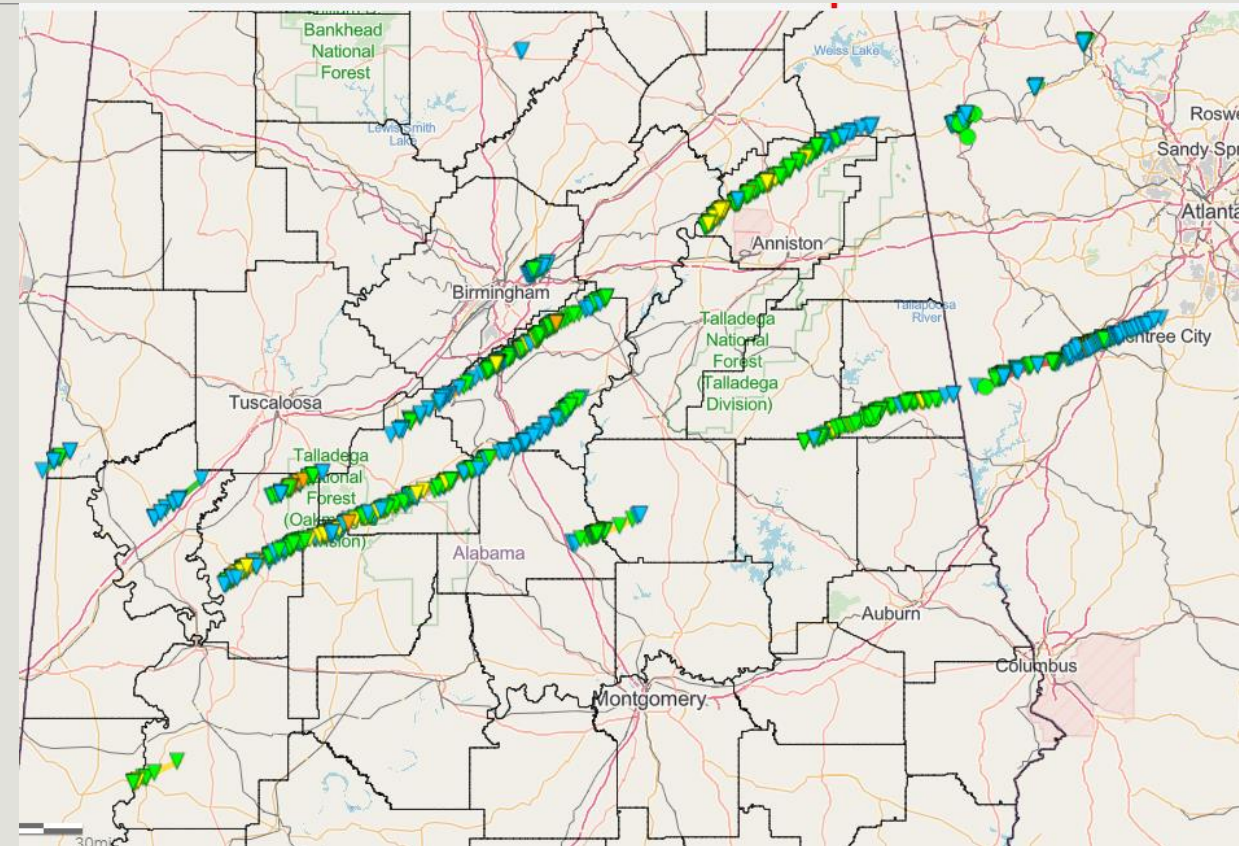
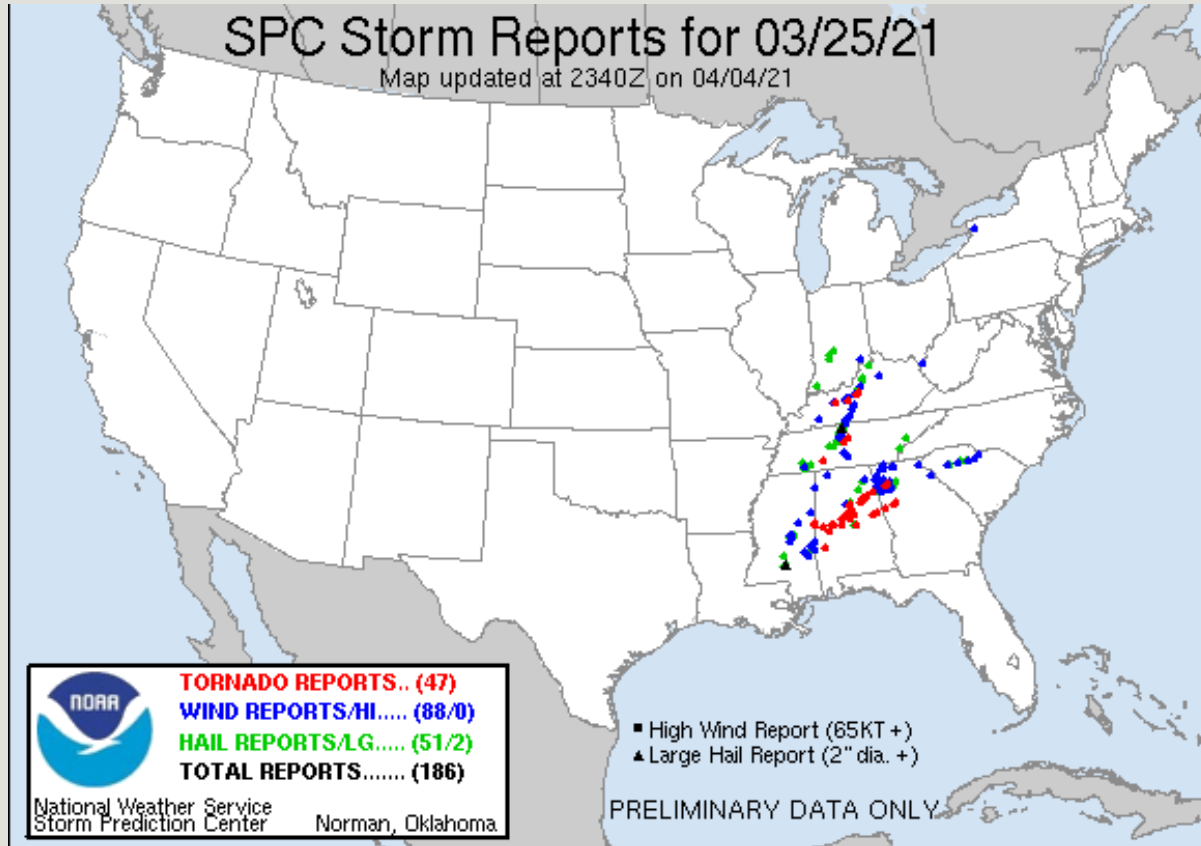
## Part II












- RADAR signatures
- Tornadogenesis
- Demo a severe weather event



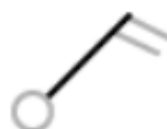


# March 25, 2021 Case Review (Multiple strong long track tornadoes)



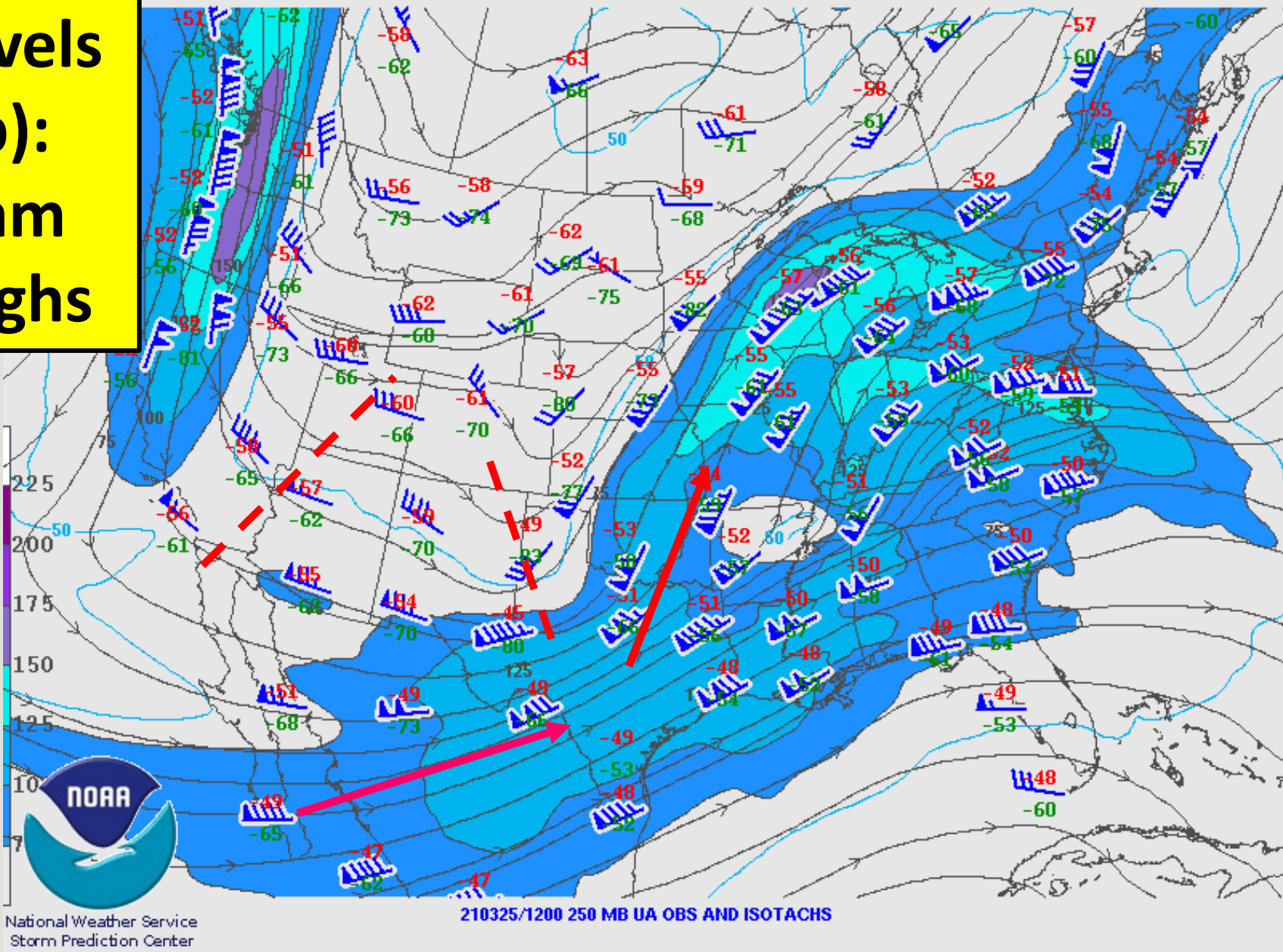
Observed wind speed	0-2 kts (0-2 mph)	3-7 kts (3-8 mph)	8-12 kts (9-14 mph)	13-17 kts (15-20 mph)	18-22 kts (21-25 mph)	23-27 kts (26-31 mph)	28-32 kts (32-37 mph)	33-37 kts (38-43 mph)	48-52 kts (55-60 mph)	53-57 kts (61-66 mph)	58-62 kts (67-71 mph)
Rounded to the nearest 5	0 kts	5 kts	10 kts	15 kts	20 kts	25 kts	30 kts	35 kts	50 kts	55 kts	60 kts
Plotted as											

Wind FROM 340° (NNW)    Wind FROM 040° (NE)    Wind FROM 190° (S)



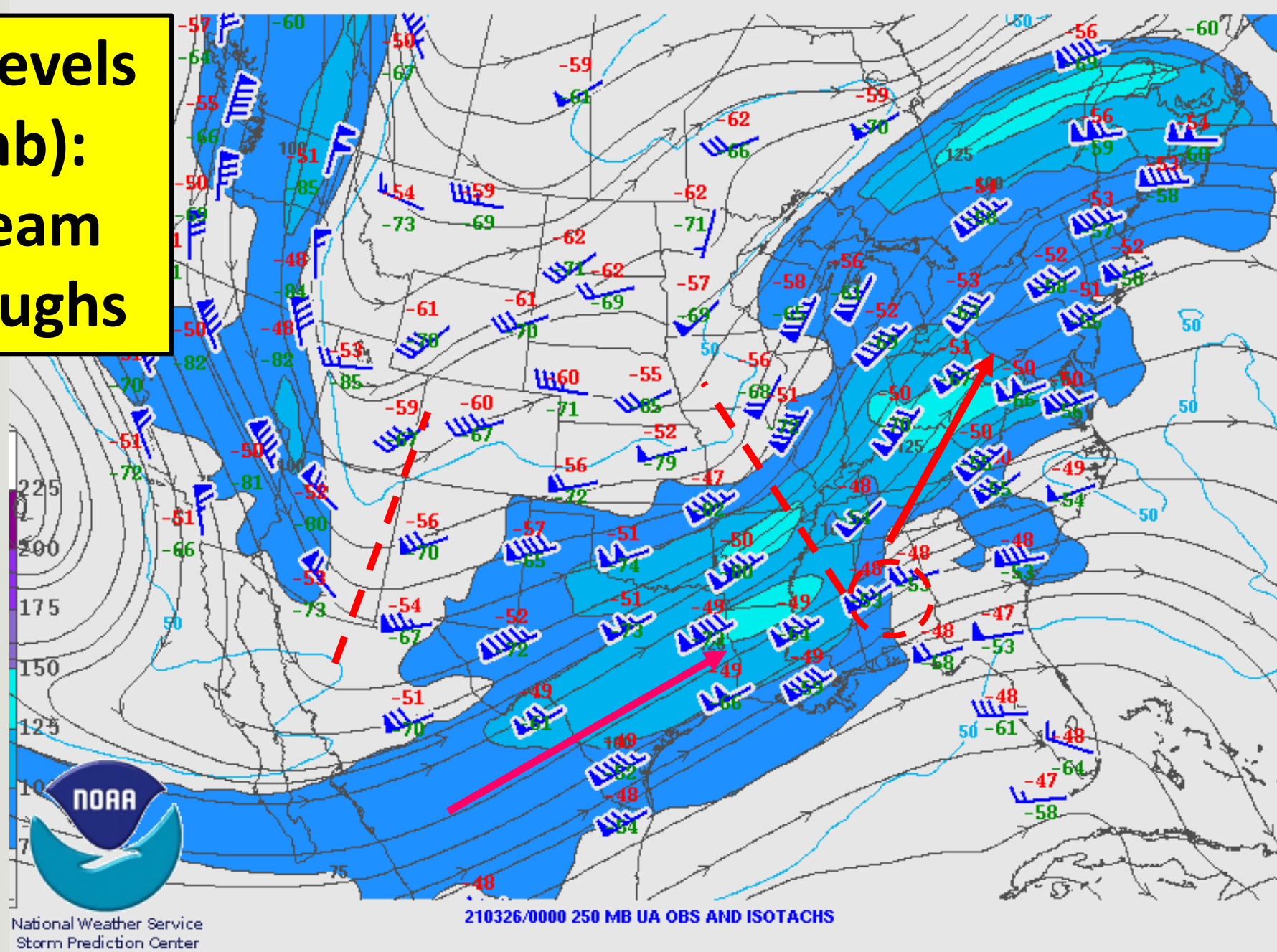
**Upper-levels  
(250mb):  
jet stream  
and troughs**

<https://www.spc.noaa.gov/obswx/maps/>



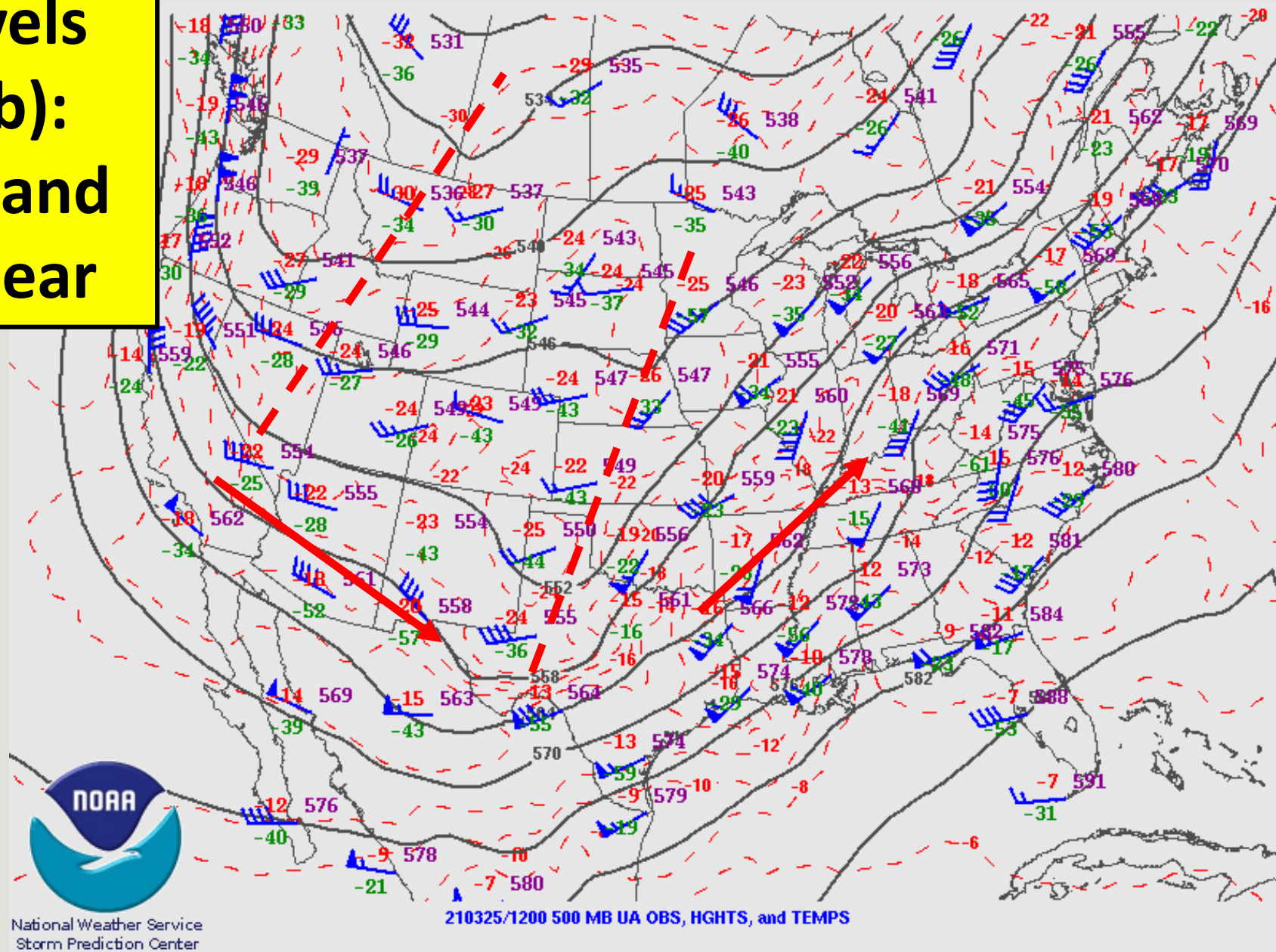


# Upper-levels (250mb): jet stream and troughs

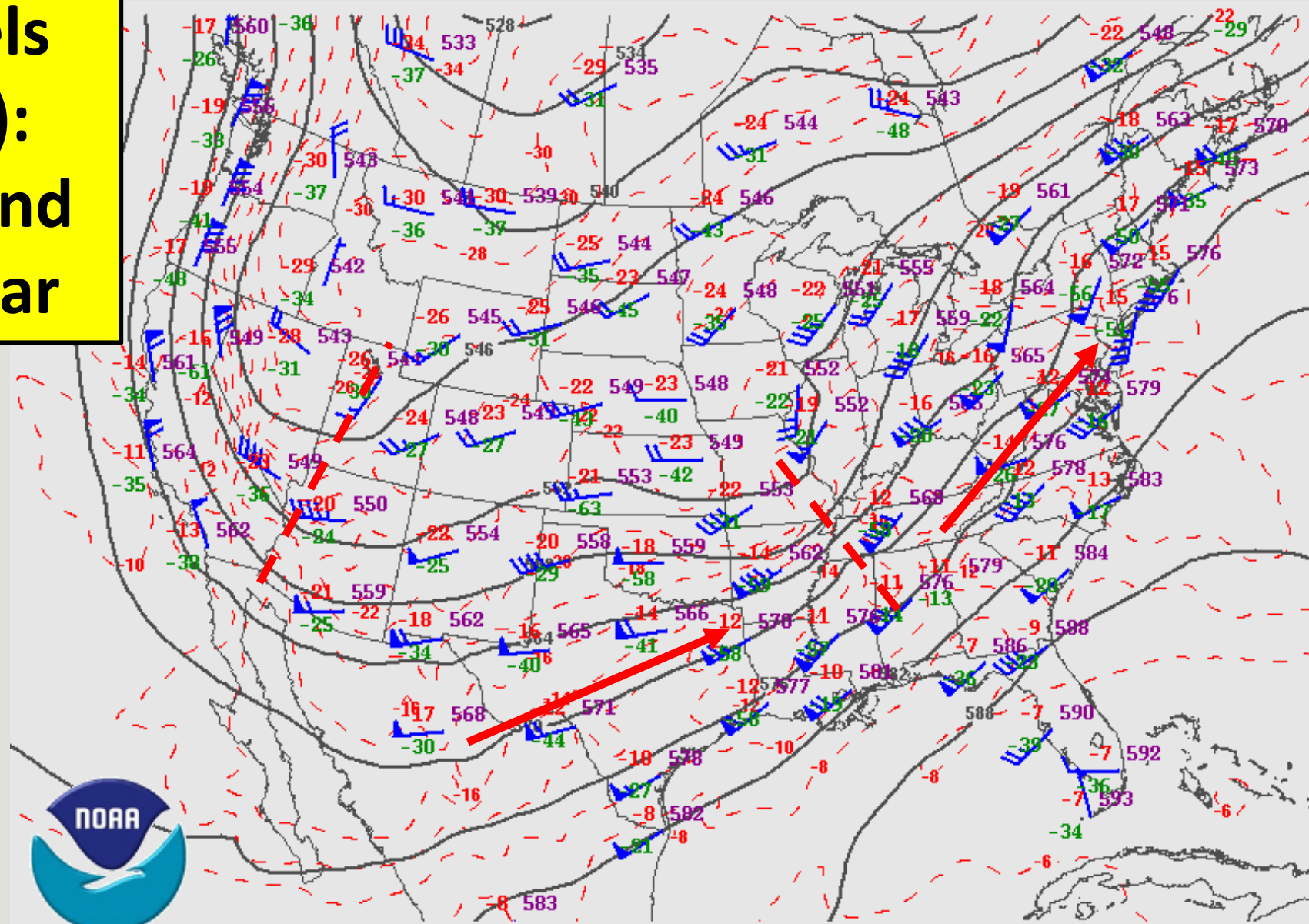




# Mid-levels (500mb): troughs and wind shear



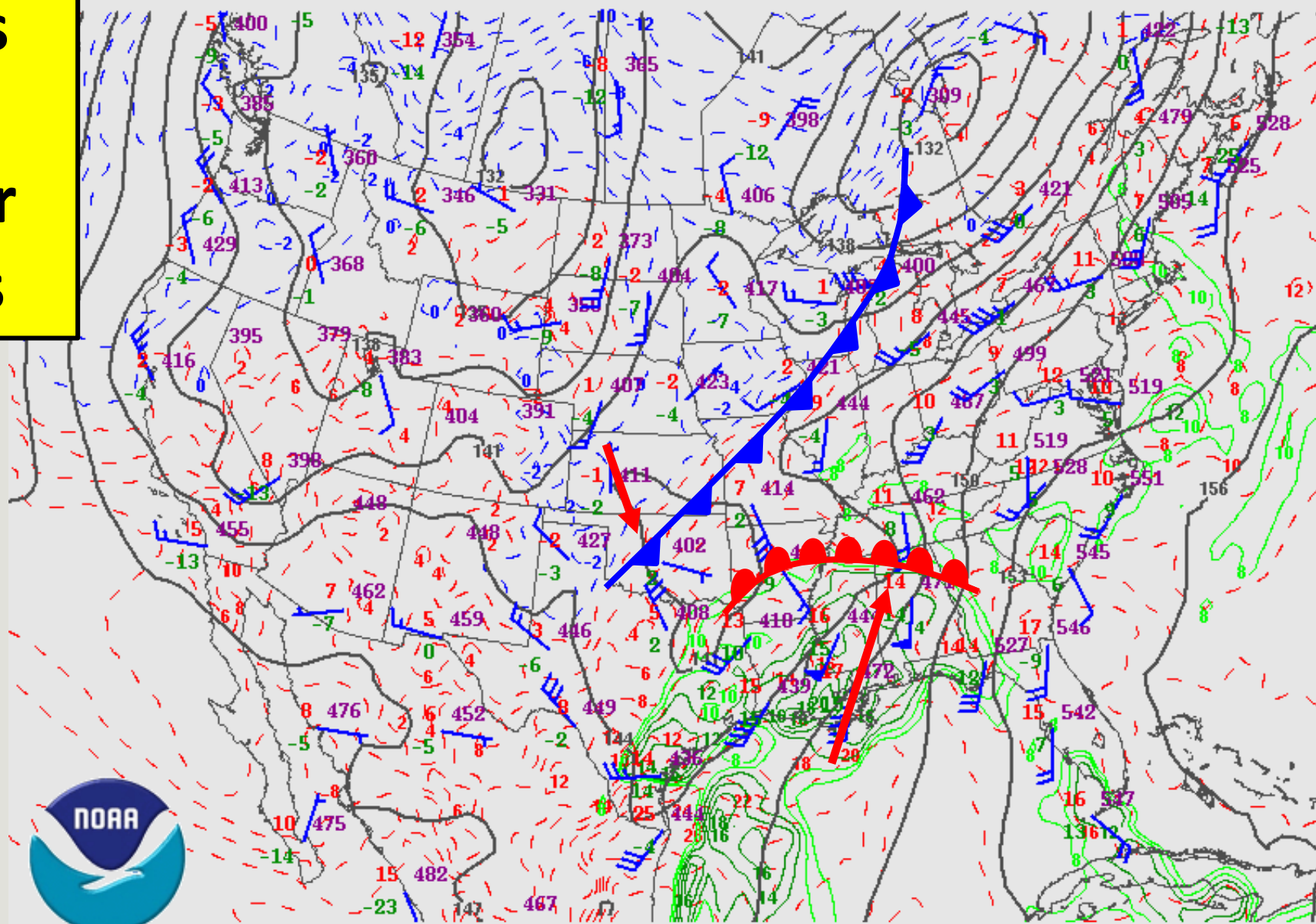
# Mid-levels (500mb): troughs and wind shear



National Weather Service  
Storm Prediction Center

210326/0000 500 MB UA OBS, HGHTS, and TEMPS

# Low-levels (850mb): wind shear and fronts

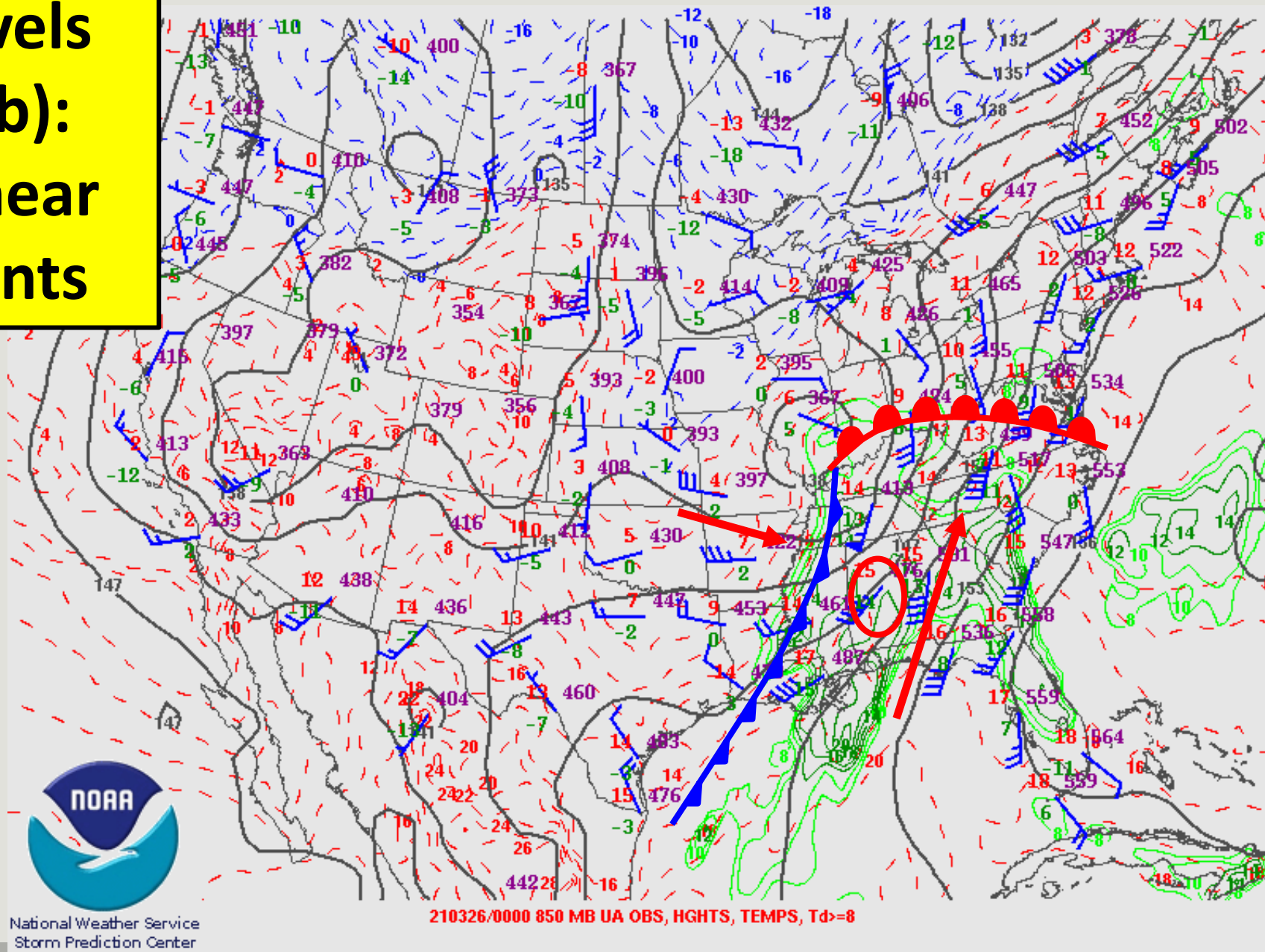


National Weather Service  
Storm Prediction Center

210325/1200 850 MB UA OBS, HGHTS, TEMPS, Td>=8



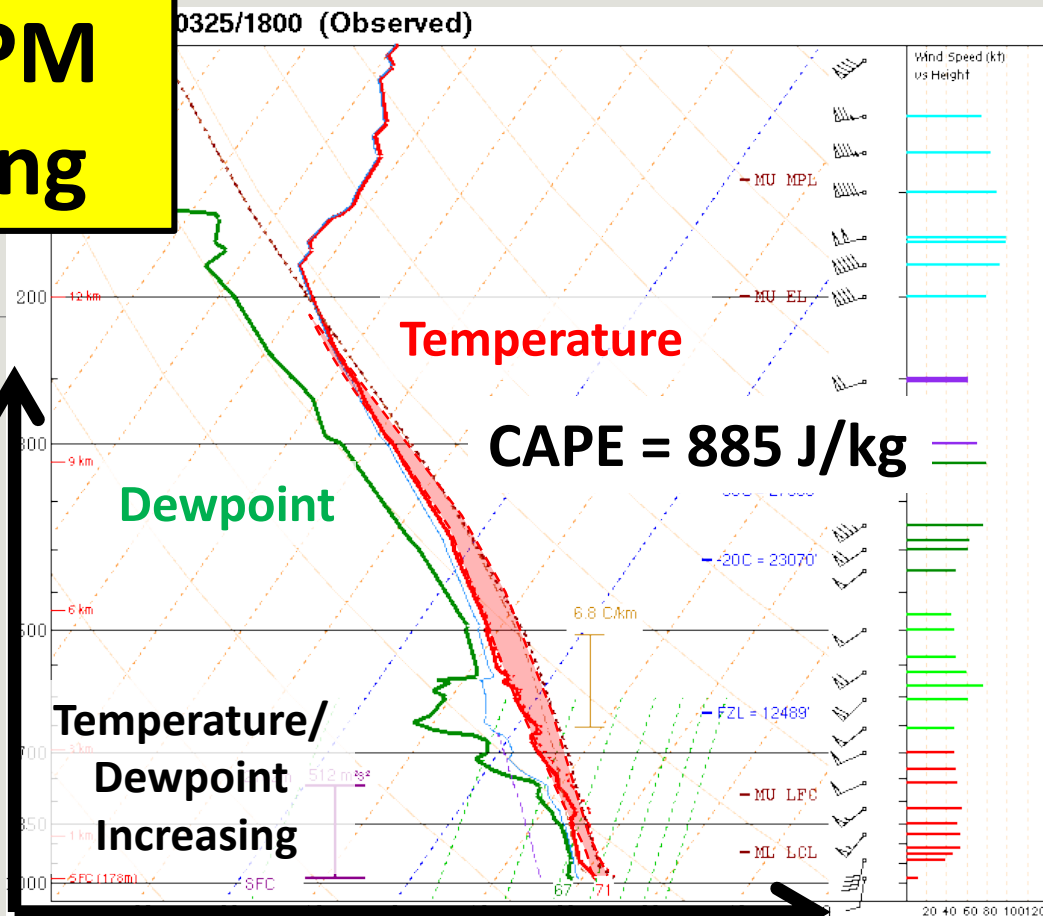
# Low-levels (850mb): wind shear and fronts





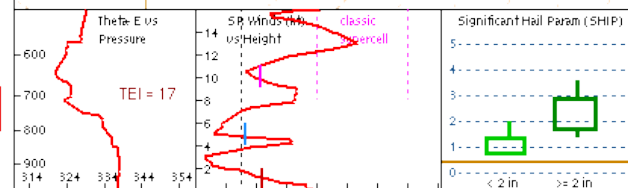
# BMX 1PM Sounding

Height Increasing



0-1km SRH = 462 m<sup>2</sup>/s<sup>2</sup>

Curved low-level hodograph



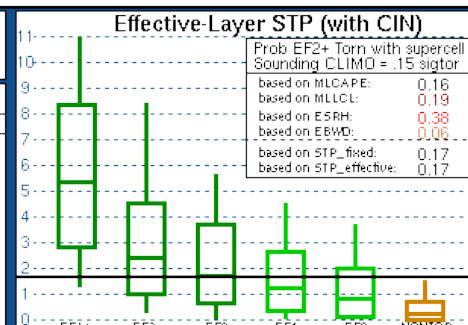
PARCEL	CAPE	CINH	LCL	LI	LFC	EL
SURFACE	885	-24	294m	-4	1958m	39364'
MIXED LAYER	727	-29	628m	-3	2065m	37555'
FCST SURFACE	1780	0	1151m	-6	1151m	41724'
MU (990 mb)	885	-24	294m	-4	1958m	39364'
PW = 1.55 in	3CAPE = 35 J/kg	WBZ = 10611'	WWDG = 0.0			
K = 33	DCAPE = 592 J/kg	FZL = 12489'	ESP = 0.0			
MidRH = 62%	Downt = 60 F	ConvT = 77 F	MMP = 0.83			
LowRH = 91%	MeanW = 13.4 g/kg	MaxT = 81 F	NCAPE = 0.09			
SigSevere = 14511 m3/s3						
Sfc-3km Agl Lapse Rate = 5.7 C/km						
3-6km Agl Lapse Rate = 6.0 C/km						
850-500mb Lapse Rate = 6.0 C/km						
700-500mb Lapse Rate = 6.1 C/km						

Supercell = 8.8  
Left Supercell = 2.8  
STP (eff layer) = 1.6  
STP (fix layer) = 1.8  
Sig Hail = 0.4

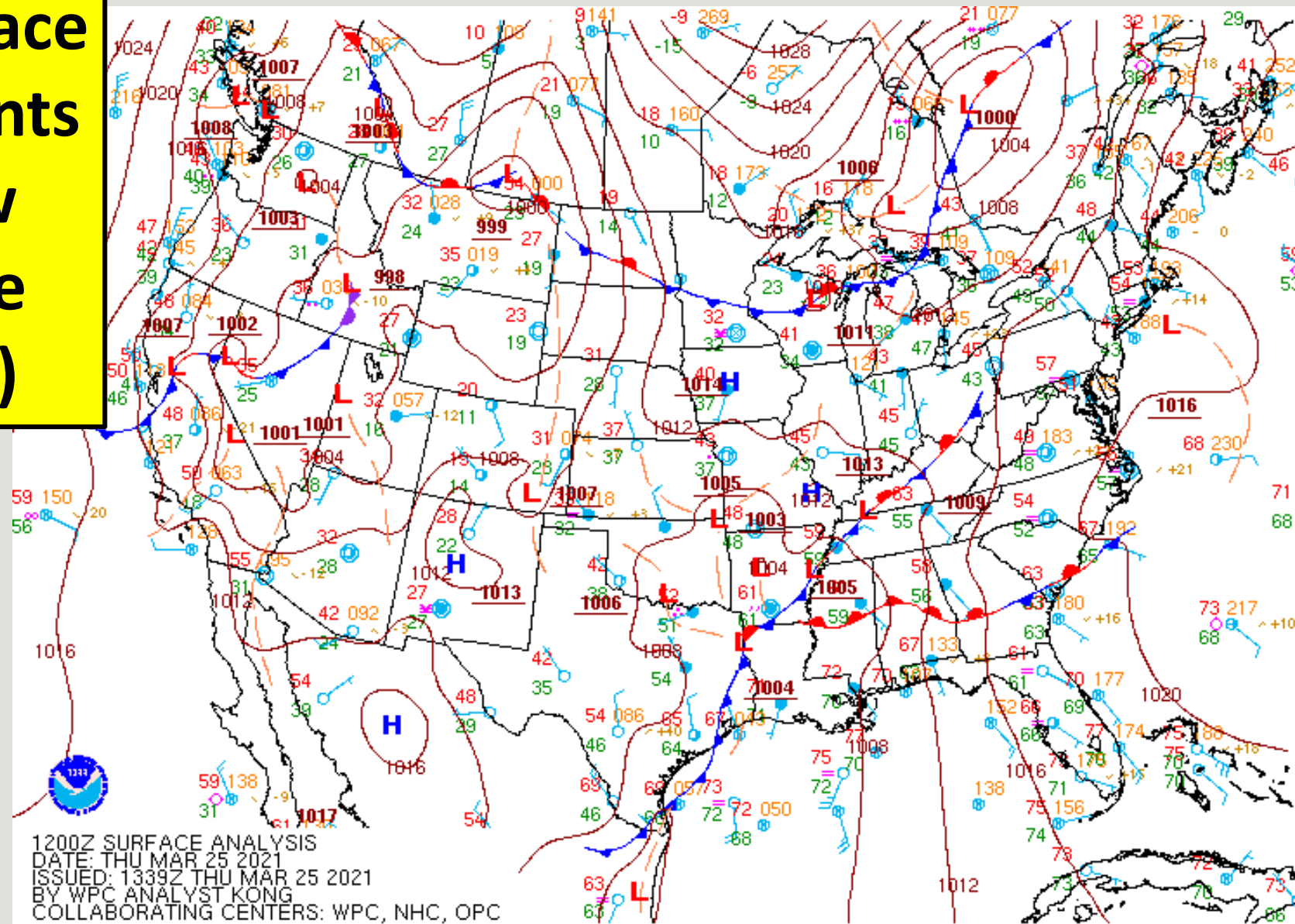
SRH(m2/s2)	Shear(kt)	MnWind	SRW
SFC - 1 km	462	44	205/38
SFC - 3 km	517	43	226/44
Eff Inflow Layer	512	46	219/43
SFC - 6 km	39	39	228/47
SFC - 8 km	70	70	228/48
LCL - EL (Cloud Layer)	68	231/53	173/14
Eff Shear (EBWD)	39	228/47	148/15
BRN Shear = 107 m/s²			
4-6km SR Wind = 189/17 kt			
Storm Motion Vectors			
Bunkers Right = 246/46 kt			
Bunkers Left = 213/53 kt			
Corfidi Downshear = 247/77 kt			
Corfidi Upshear = 276/24 kt			



*** BEST GUESS PRECIP TYPE ***	
Rain.	
Based on sfc temperature of 70.9 F.	
SARS - Sounding Analogs	
SUPERCCELL	SGFNT HAIL
No Quality Matches	No Quality Matches
(10 loose matches) SARS: 70% TOR	(1 loose matches) SARS: 0% SIG

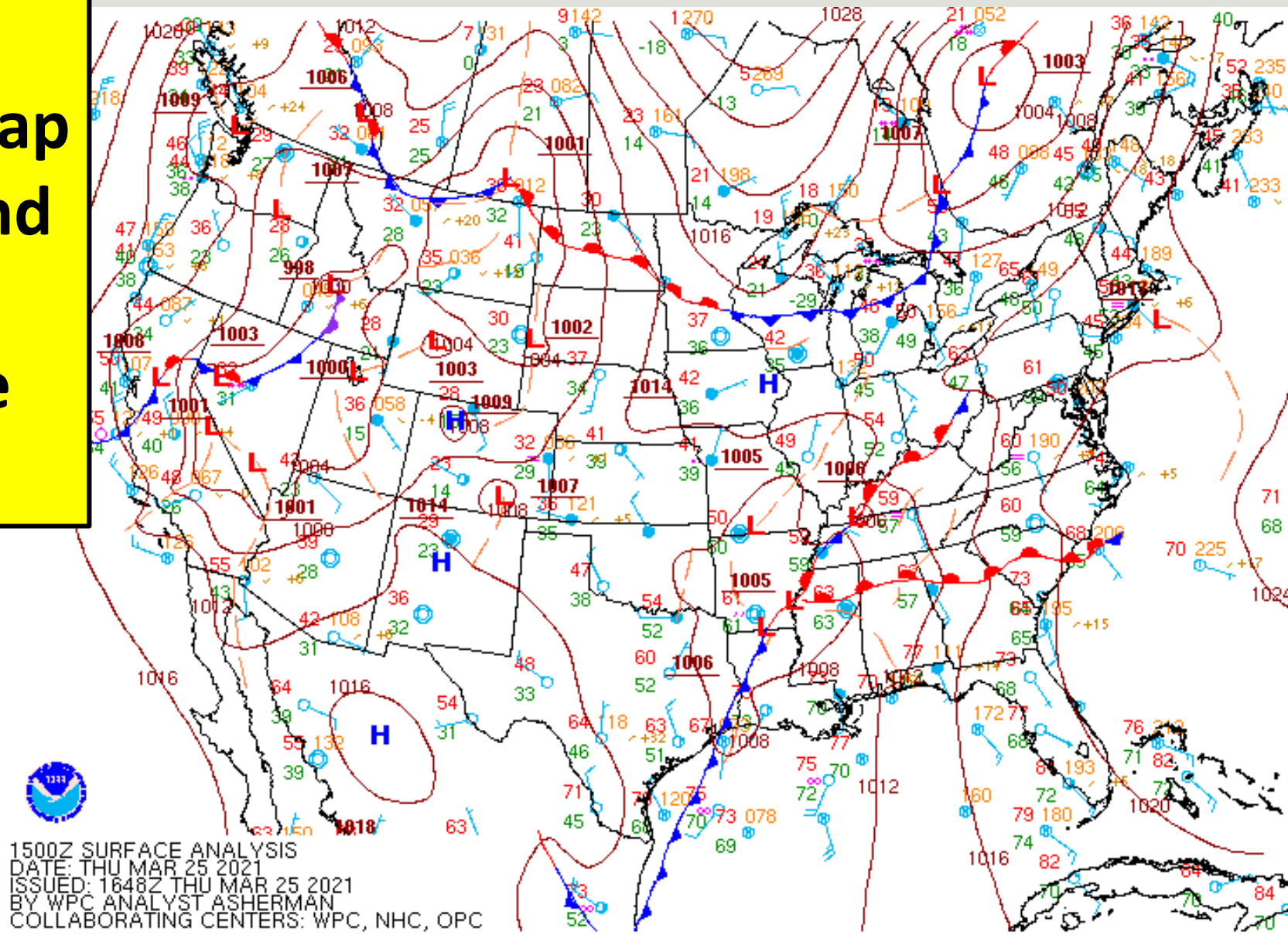


# 7AM Surface Map (Fronts and low pressure centers)

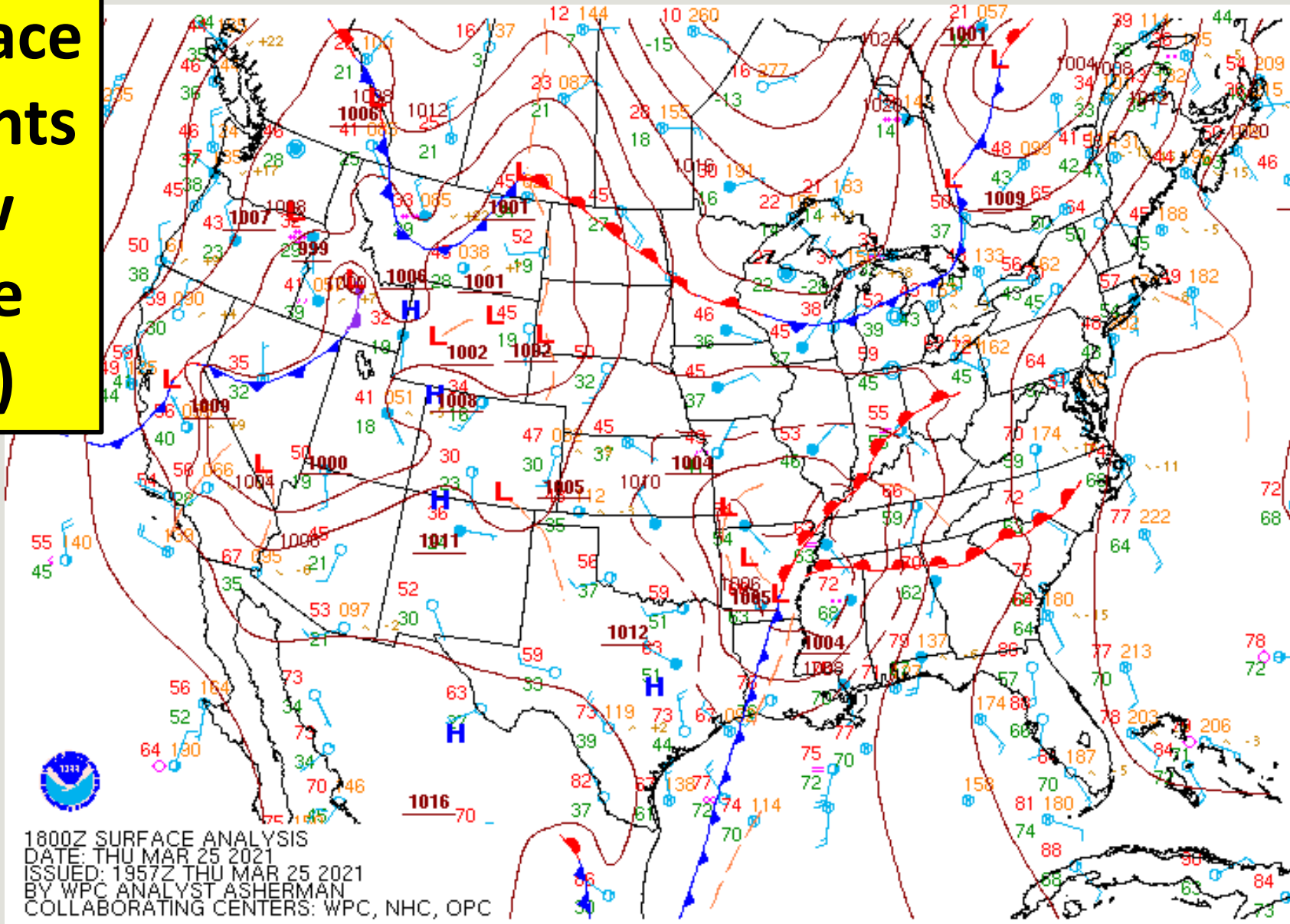


<https://www.wpc.ncep.noaa.gov/html/sfc2.shtml>

# 10 AM Surface Map (Fronts and low pressure centers)

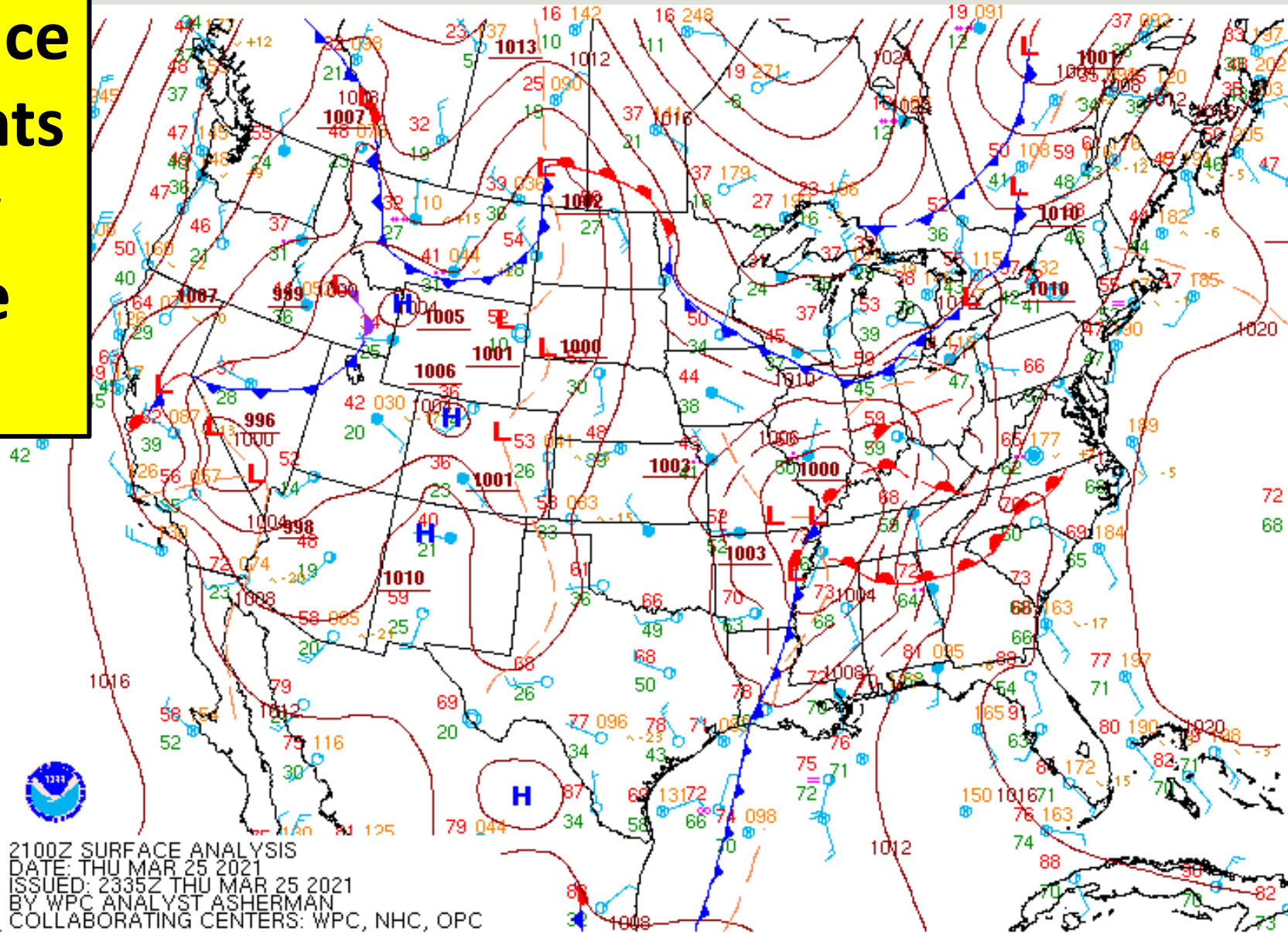


# 1PM Surface Map (Fronts and low pressure centers)

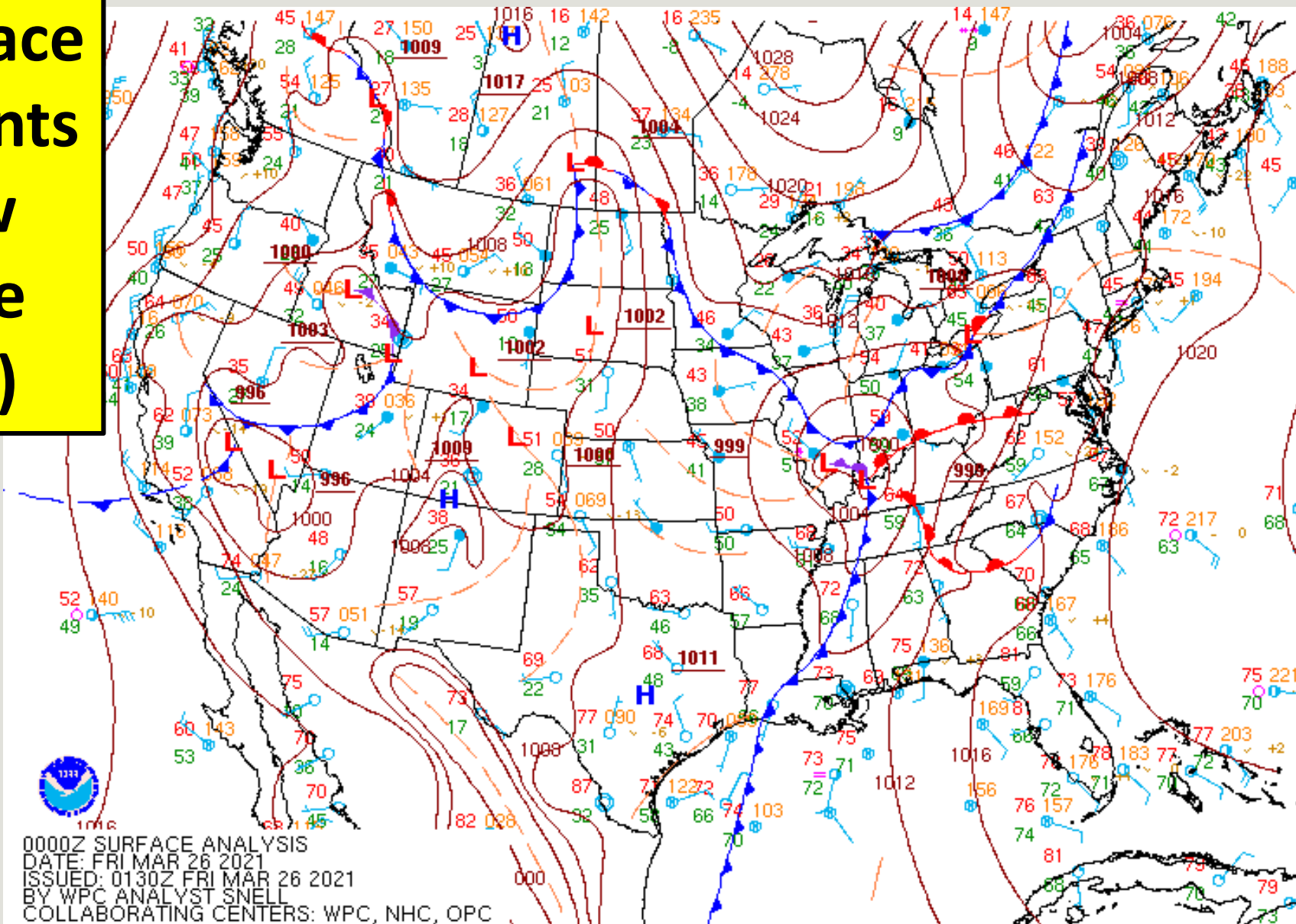




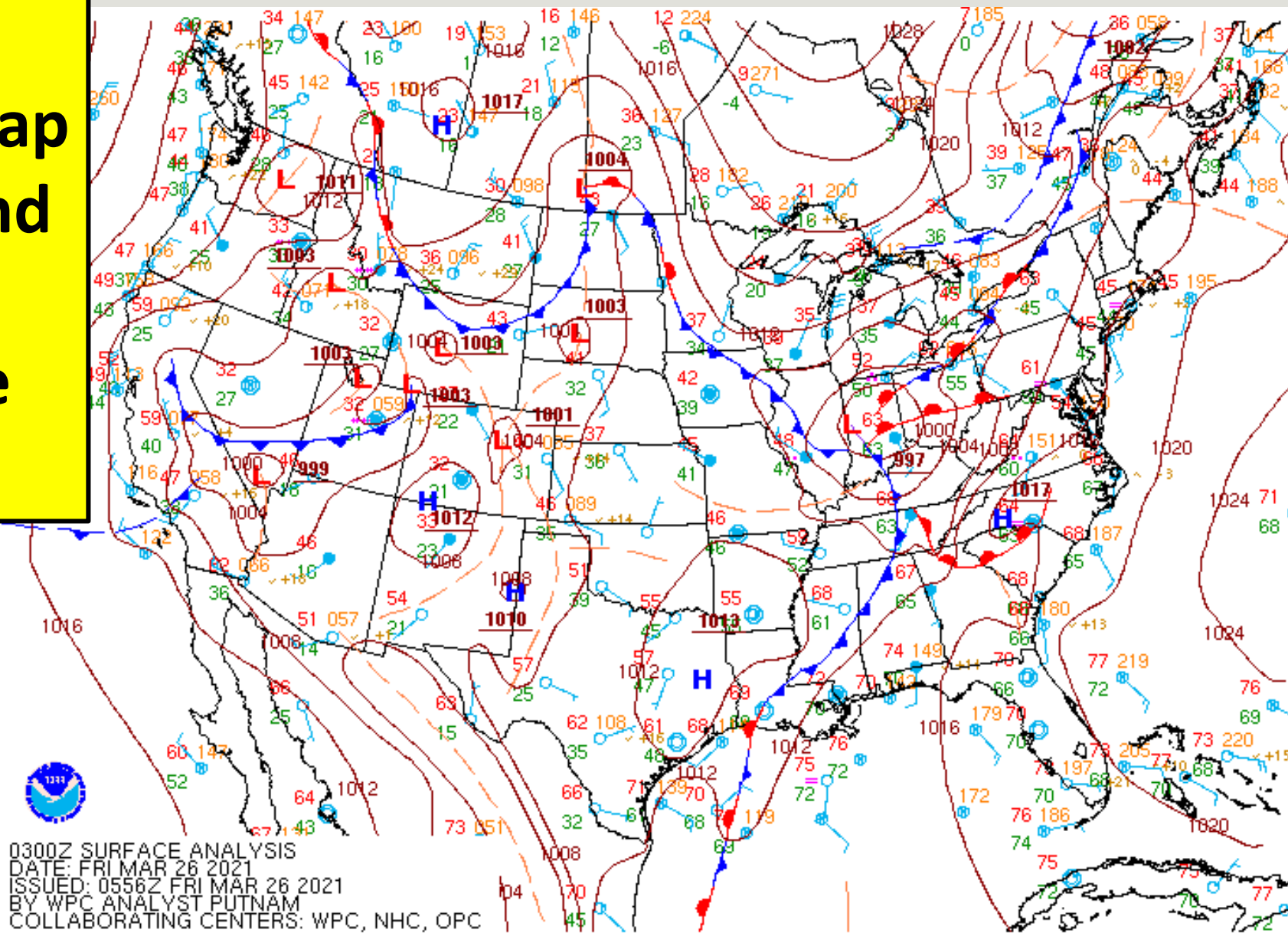
# 4PM Surface Map (Fronts and low pressure centers)



# 7PM Surface Map (Fronts and low pressure centers)

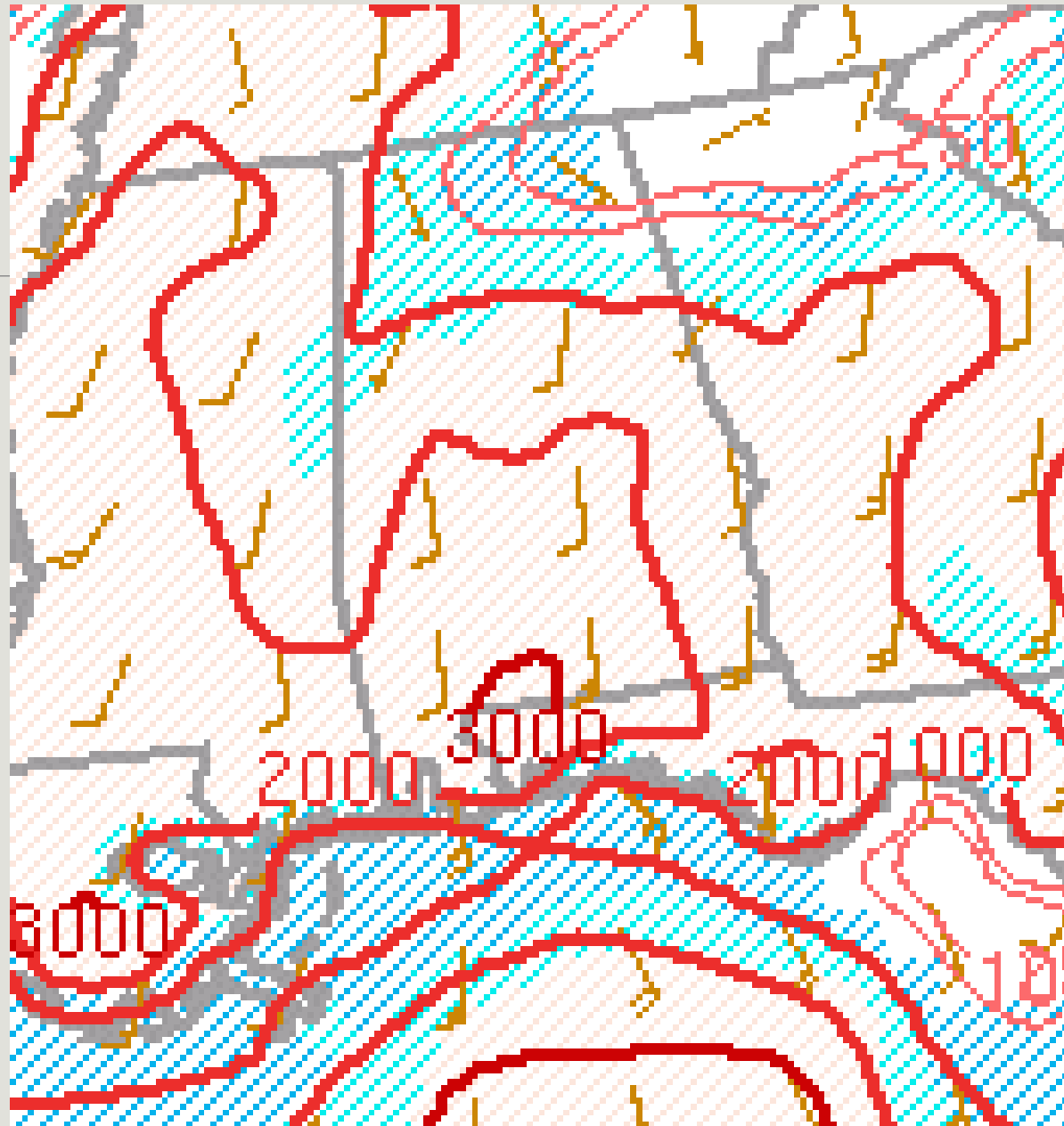


# 10PM Surface Map (Fronts and low pressure centers)



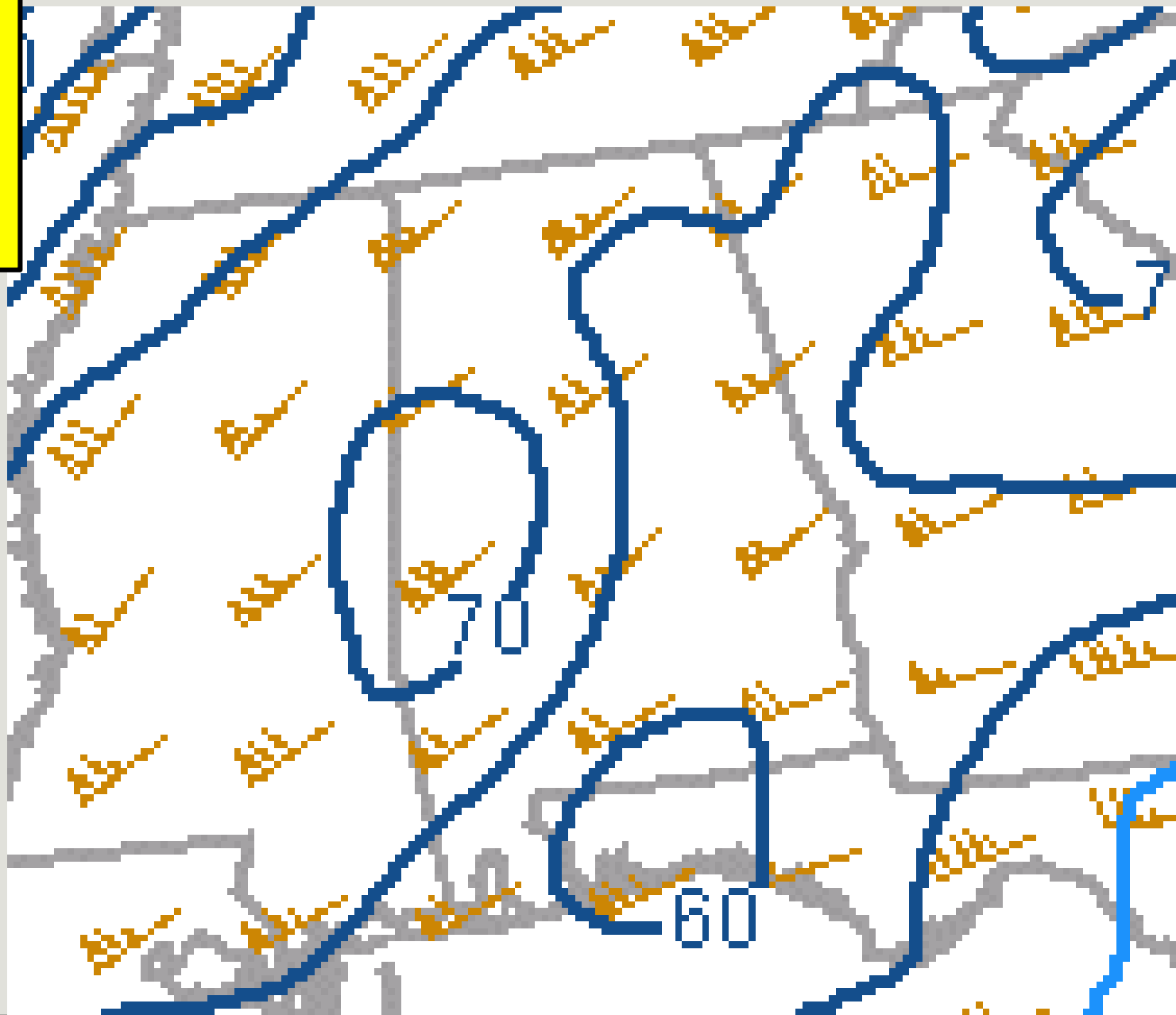
**Convective  
Available  
Potential  
Energy  
(CAPE):  
~2000 J/kg**

<https://www.spc.noaa.gov/exper/mesoanalyses/>

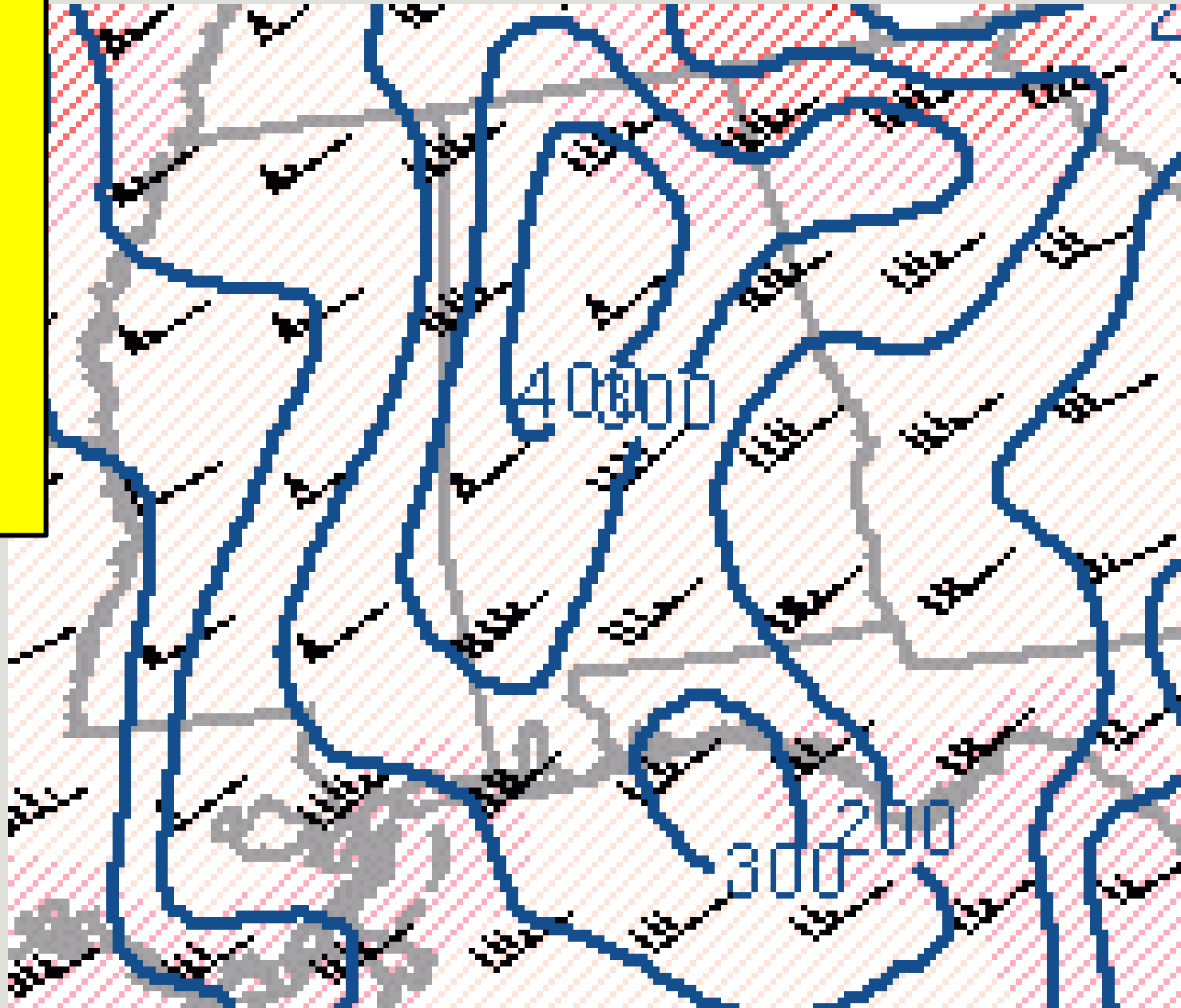




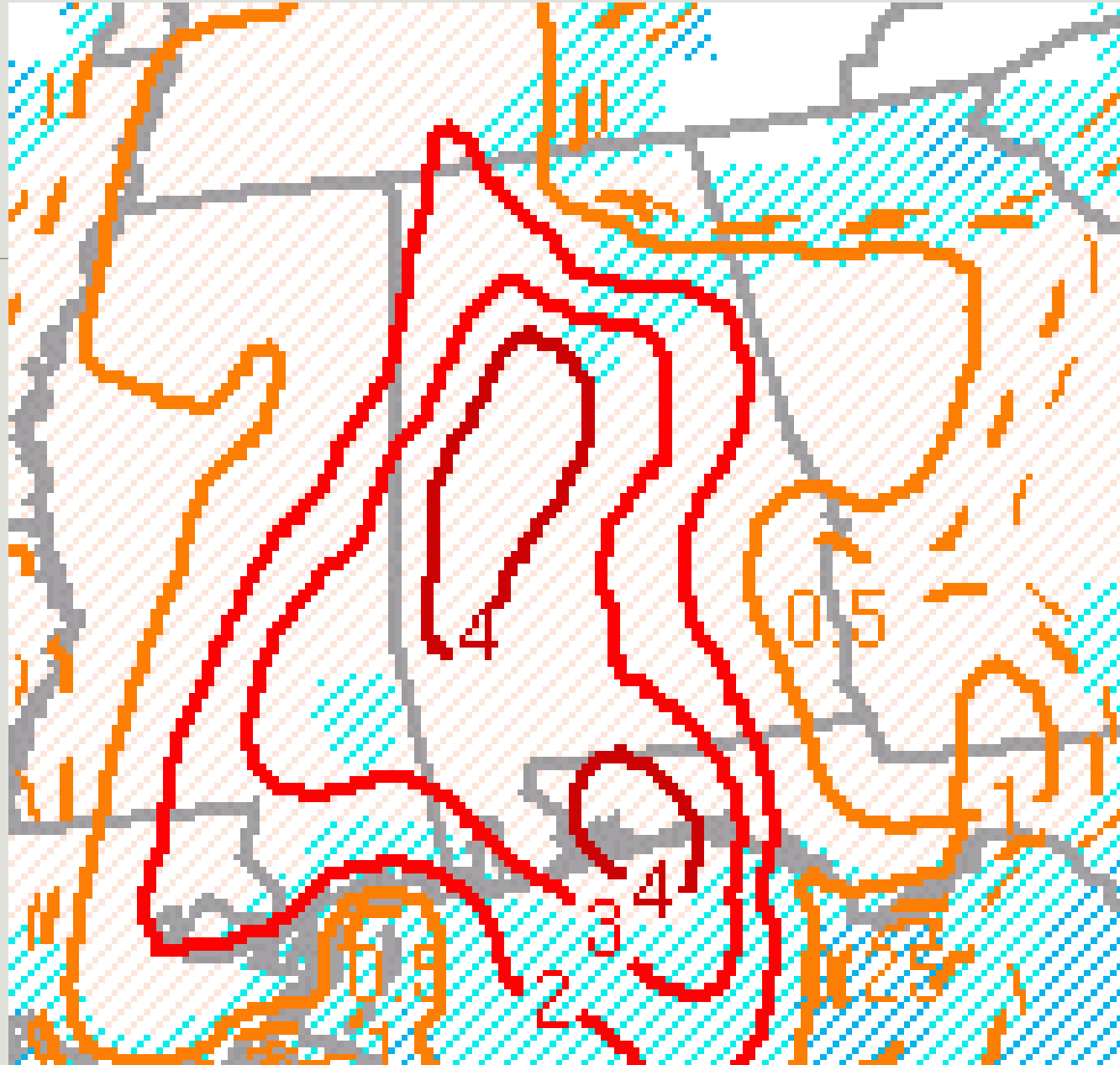
**0-6km bulk  
wind shear:  
~70 kts**



**Effective  
storm  
relative  
helicity  
(SRH):  
 $\sim 400 \text{ m}^2/\text{s}^2$**



**Significant  
Tornado  
Parameter  
(STP):  
~4**



# Severe Weather Outlook

## Severe Weather Outbreak

Thru Midnight

Weather Forecast Office  
Birmingham, AL

Issued March 25, 2021 12:06 PM CT



**High Risk:** Strong to violent tornadoes/Damaging winds up to 80 mph/Golf ball size hail

**Moderate Risk:** Strong tornadoes/Damaging winds up to 70 mph/Golf ball size hail

**Enhanced Risk:** Tornadoes/Damaging winds up to 60 mph/Quarter size hail

**Slight Risk:** A tornado possible/Damaging winds up to 60 mph/Quarter size hail

**Marginal Risk:** Minimal threat of a tornado and damaging winds

### Threat Area



### Threat Timing



Marginal

Slight

Enhanced

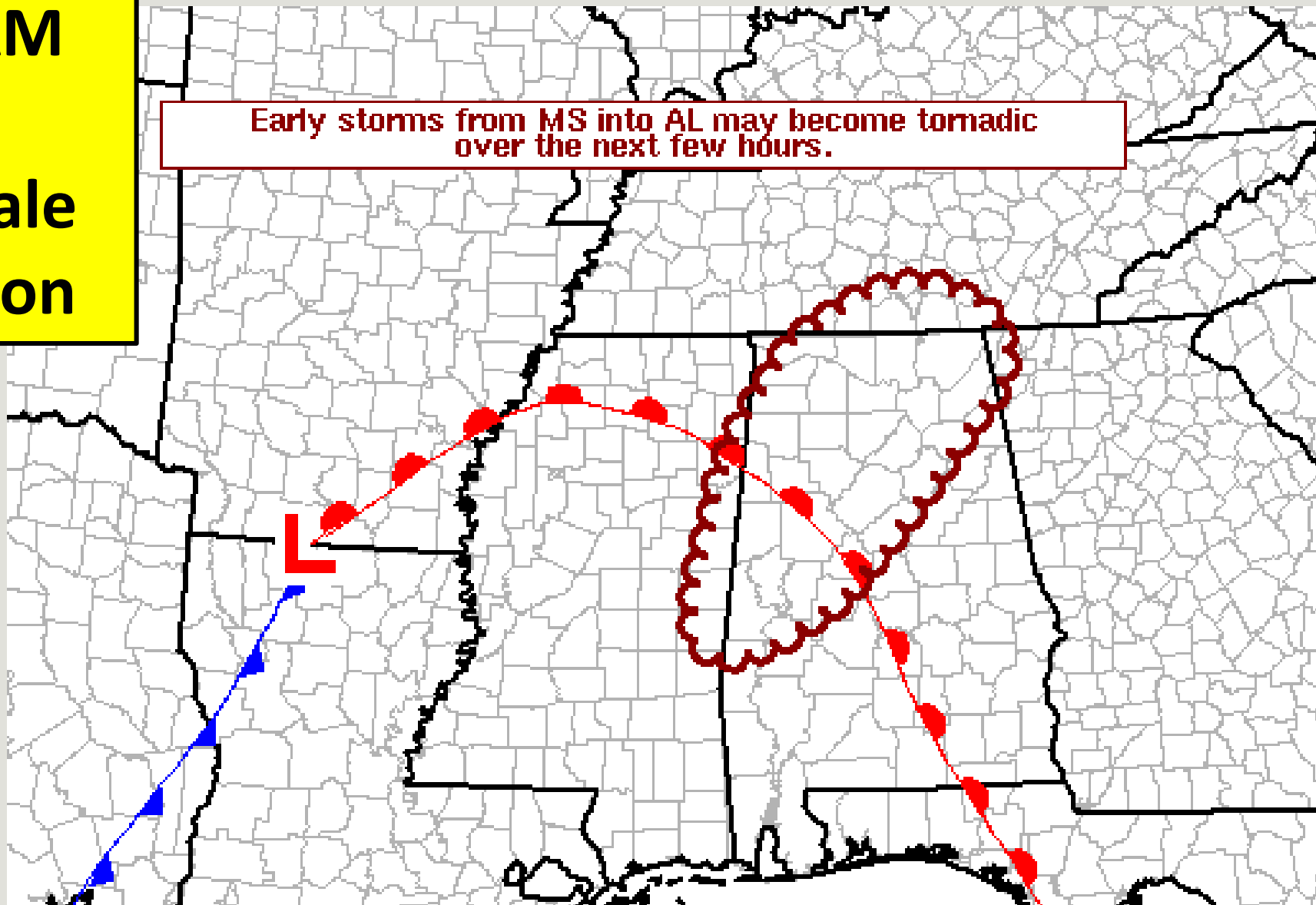
Moderate

High



**10:15 AM  
SPC  
Mesoscale  
Discussion**

Early storms from MS into AL may become tornadic over the next few hours.



SPC MCD #0252

# 11:30 AM SPC Tornado Watch

## Particularly Dangerous Situation (PDS) Tornado Watch 50

< Previous WW      Next WW >

Public | Counties | Probabilities | Aviation | Warnings | Initial RADAR | Related MD



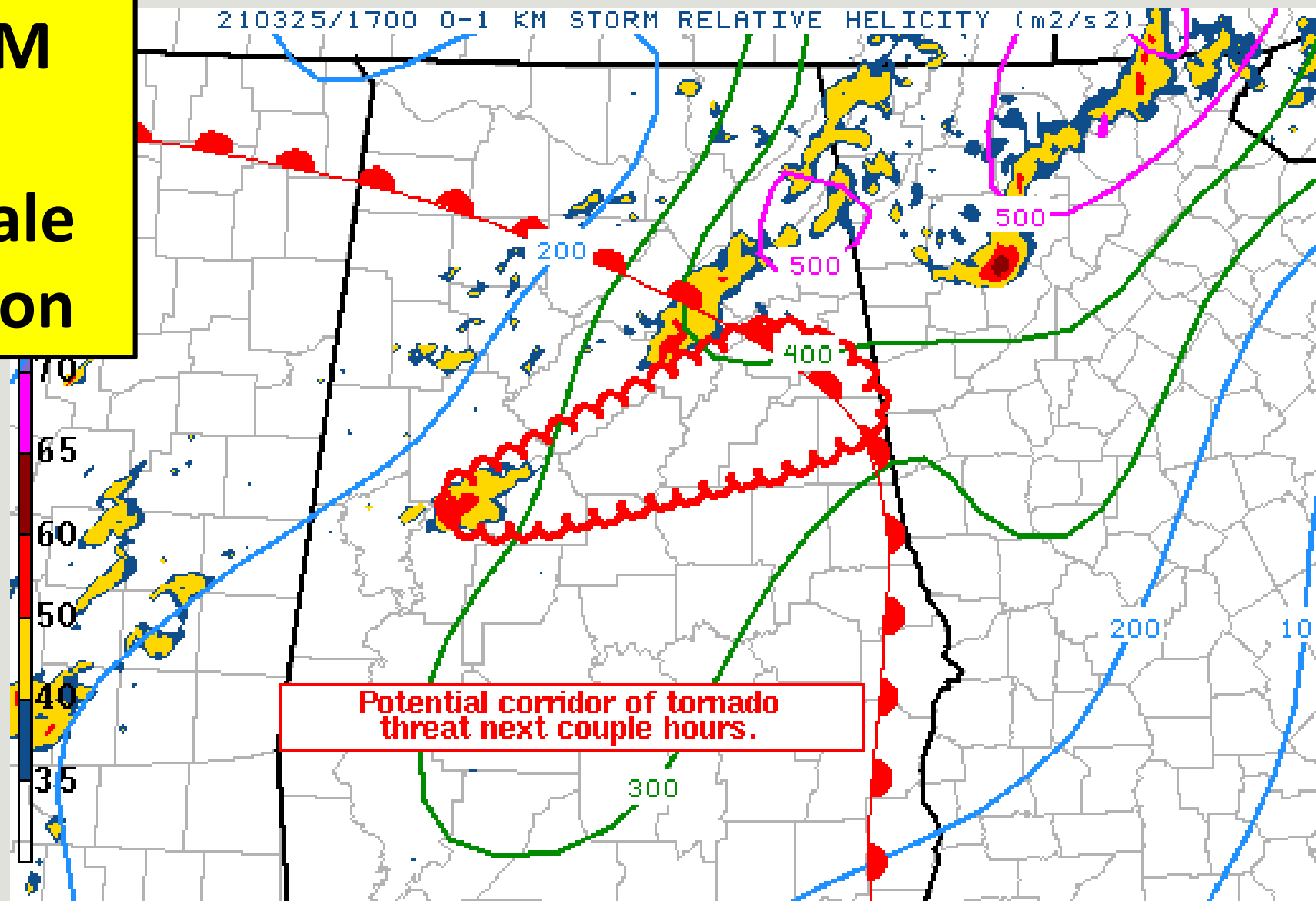
**Tornado Watch # 50 - Valid from 1125 AM until 800 PM CDT**

NOAA/NWS/Storm Prediction Center

Updated: 20210325/1632 UTC

Hazard	Tornadoes	EF2+ Tornadoes	Severe Wind	65 kt+ Wind	Severe Hail	2"+ Hail
Likelihood	High	High	High	High	High	Moderate

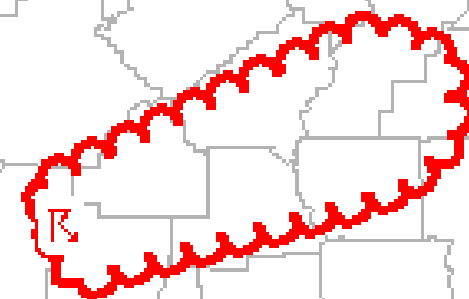
**12:30PM**  
**SPC**  
**Mesoscale**  
**Discussion**



SPC MCD #0255

**4:45PM**  
**SPC**  
**Mesoscale**  
**Discussion**

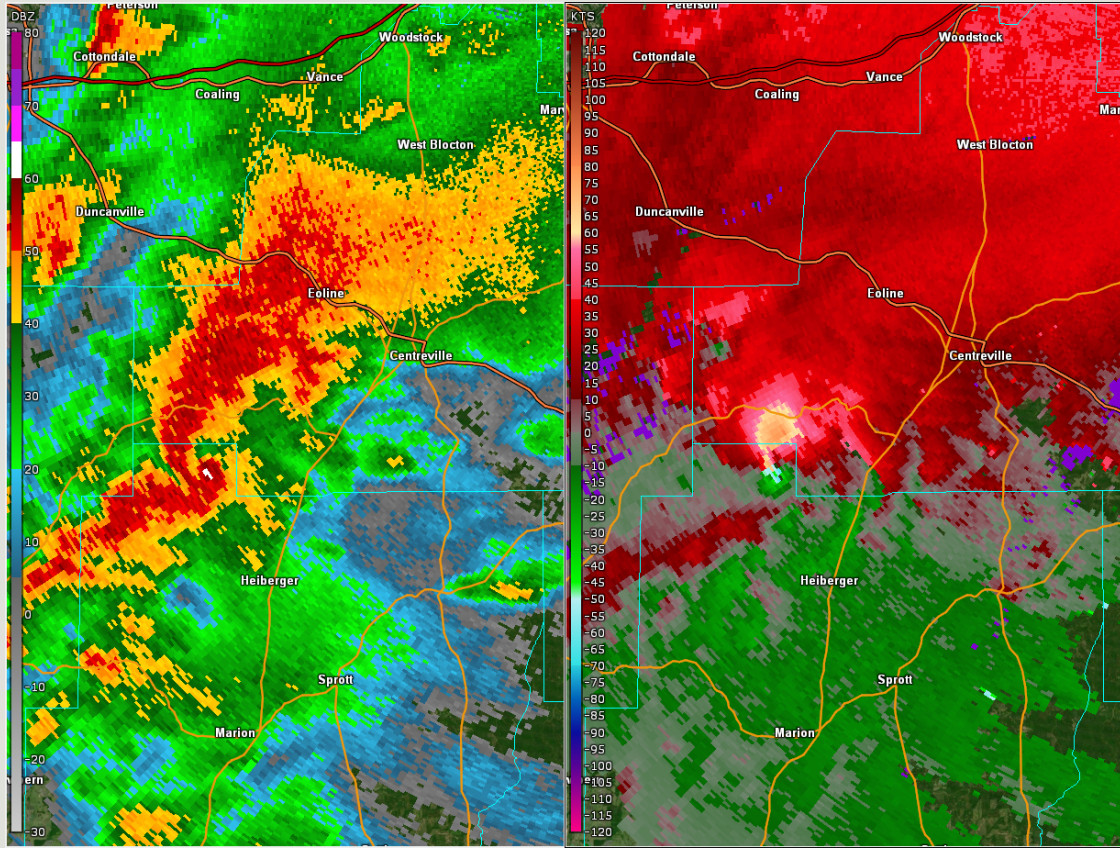
**Intense tornado corridor ongoing/expected over the  
next 1-2 hours.**



**SPC MCD #0261**



# Radar Images



# Further Training

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- COMET MetEd Modules (<https://www.meted.ucar.edu/index.php>)
  - Hundreds of free modules about all kinds of meteorological topics
- SPC Video Lecture series (<https://www.spc.noaa.gov/exper/spcousom/>)
  - Collection of lectures on severe storms from Storm Prediction Center forecasters and others given to a University of Oklahoma class
- NWS Warning Decision Training Branch Radar Applications Course (<https://training.weather.gov/wdtd/courses/rac/outline.php>) and Warning Operations Course (<https://training.weather.gov/wdtd/courses/woc/severe.php>)
  - Choose the “Web version” of each module which doesn’t require a login



# Additional Materials

Visit our SKYWARN spotter page for useful links and information: [weather.gov/bmx/skywarnschedule](https://weather.gov/bmx/skywarnschedule)

- This presentation in PDF format
- Spotter schedule
- Training materials
- Brochures and guides
- Certificate > [weather.gov/bmx/advancedspottertraining](https://weather.gov/bmx/advancedspottertraining)

